Fishes. 2

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GEORGE M. BOWERS, Commissioner.

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PREFATORY NOTE.

U. S. Commission of Fish and Fisheries,
Washington, D. C., May 1, 1899.

The present Bulletin contains three papers emanating from the biological laboratory of the Commission at Woods Hole, Mass. These are the first of a series of articles presenting the results of scientific and economic investigations conducted at that station. These investigations, which cover a very wide range of subjects pertaining to aquatic biology, are for the most part carried on by scientists prominent in their various branches, who are attracted to the station by the opportunities for study there afforded, and who give to the Commission, without remuneration, the results of their labors.

By affording facilities to those persons who may profit by the use of the material available at its various stations, the Commission not only aids in the general progress of science, but extends its own field of usefulness, if biological problems of even remote economic bearing are solved through the study of the fish or other animals procurable at the laboratory. It was the earnest desire of the late Professor Baird, the founder of the laboratory, that opportunity for such special research should be provided, and during the past year, without in any way interfering with the other work of the station and at practically no expense to the Government, a number of specialists have been enabled to carry on researches which have yielded results of scientific importance.

The recent action of the Commission in making provision for keeping the laboratory open throughout the year has been warmly indorsed, and will, it is thought, prove most beneficial in advancing the interests of marine biology.

George M. Bowers,
Commissioner.

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REPORT OF THE OPERATIONS OF THE UNITED STATES FISH COMMISSION STEAMER ALBATROSS FOR THE YEAR ENDING JUNE 30, 1898.

By JEFFERSON F. MOSER,

Commander, United States Navy, Commanding.

INTRODUCTORY.

The following report of the operations of the steamer *Albatross* and party under my command for the fiscal year ending June 30, 1898, is respectfully submitted:

In order to cover in one report the work of the summer of 1897 it will be necessary to refer to the time of the arrival of the party in the field, a date earlier than June 30, 1897, the time of closing my previous report.

While the *Albatross* was engaged in setting deep sea gill nets along the edge of the Pacific plateau for the purpose of ascertaining, if possible, the sea salmon-grounds, instructions were received, under date of April 23, 1897, directing the vessel to visit Alaska, for the purpose of investigating the salmon and halibut fisheries.

Under these instructions, modified by subsequent experience, the plan of work for the investigation of the salmon streams and the salmon industry of Alaska was laid out as follows: To commence at the southern boundary and work in detail to the northward and westward, visiting all canneries and all streams carrying commercial salmon, whether fished or not; to obtain at the canneries statistics of streams fished by them, reaching over as many years as the records would furnish data, and, in addition, detailed statistics regarding the persons, vessels, boats, and apparatus employed in the fisheries, together with the catch and pack of the various species of salmon; to explore the streams and lakes and ascertain the general features and characteristics, so far as they relate to salmon and other fishes, spawning-grounds, condition and nature of the water, character of shores, vegetation, species of salmon entering, their movements, time and duration of runs, size of fish, abundance, waste species, signs and causes of depletion, the mortality of the different species on the spawning-grounds, natural and artificial obstructions to the passage of fish, fishing methods and their relation to the maintenance of supply, data relating to conditions for hatcheries, etc.

In connection with the studies of the salmon industry it was decided that the halibut-grounds could be examined and practical information obtained as to their location, depth, extent, the abundance and size of the fish, the proper bait, and other points.

The detail of the vessel to proceed from Sitka to Bering Sea on special duty caused the abandonment of the original scheme of proceeding systematically from the southern boundary to the northward, as it was thought advisable, after fulfilling the mission referred to, to examine the salmon fisheries along the Aleutian chain and work from the westward, instead of returning to southeast Alaska and continuing the work to the northward. By making this change all the canneries in operation in Alaska, outside of Bering Sea, and many of the streams were visited. There are, however, so many streams in the Territory, particularly in what is known as southeast Alaska, that, while the party has covered a great area and has now a thorough acquaintance with the subject, the work so far as it relates to stream and lake exploration has only been commenced.

The *Albatross* arrived at Mary Island, southeast Alaska, June 6, 1898. and pursued the following itinerary during the investigation:

Mary Island, southeast Alaska	June 6	Little River, Kadiak Island	Aug. 10
Boca de Quadra	June 7–8	Uganuk, Kadiak Island	Aug. 10–14
Ketchikan, Tongass Narrows	June 9–10	Kussilof River, Cook Inlet	Aug. 15–17
Port Chester, Annette Island	June 10–12	Port Etches, Prince William Sound	Aug. 17
Nichols Bay, Prince of Wales Island	June 12–14	Orca, Prince William Sound	Aug. 18–26
Hunter Bay, Prince of Wales Island	June 14–22	Yakutat, Yakutat Bay	Aug. 27–30
Niblack Anchorage, Prince of Wales Island	June 22–24	Sitka, Baranof Island	Aug. 31–Sept. 5
Chasina Anchorage, Prince of Wales Island	June 24–25	Redfish Bay, Baranof Island	Sept. 5–8
Karta Bay, Prince of Wales Island	June 25–28	Klawak Inlet, Prince of Wales Island	Sept. 9–18
Kasaan Bay, Prince of Wales Island	June 28	Killisnoo, Kenasnow Island	Sept. 19–21
Loring, Naha Bay	June 28–July 2	Chilkat Village	Sept. 22–25
Yes or McDonald Bay, Cleveland Peninsula	July 2–3	Point Highfield, Wrangell Island	Sept. 25
Helm Bay, Cleveland Peninsula	July 3	Loring, Naha Bay	Sept. 26–28
Thorne Bay, Prince of Wales Island	July 3–6	Ketchikan, Tongass Narrows	Sept. 28
Point Highfield, Wrangell Island	July 6–8	Metlakahtla, Annette Island	Sept. 29
Duncan Canal, southern end	July 8–9	Seattle, Washington	Oct. 8–13
Killisnoo, Kenasnow Island	July 9–11	Tacoma, Washington	Oct. 13–24
Sitka, Baranof Island	July 11–15	Seattle, Washington	Oct. 24–25
St. Paul, Kadiak Island	July 17	Union Bay, Vancouver Island	Oct. 26–29
Karluk, Kadiak Island	July 18–20	Sausalito, California	Nov. 2–Dec. 5
Dutch Harbor, Unalaska	July 23–27	Farallon Islands	Dec. 5–6
Chignik Bay, Alaska Peninsula	July 29–Aug. 2	Sausalito, California	Dec. 6–20
Karluk, Kadiak Island	Aug. 2–6	San Diego Bay, California	Dec. 22–31
Uyak Bay, Kadiak Island	Aug. 6–10		

Many of the points visited were unsurveyed, and existing sketches were found to be unreliable and inaccurate. In addition to the regular work connected with the investigations, many reconnaissances and sextant surveys were made, astronomical observations for latitude, longitude, and magnetic declination were taken, and hydrographic notes and sailing directions collated.

At Karluk, Kadiak Island, Mr. A. B. Alexander, fishery expert attached to the *Albatross*, was landed, to make inquiries concerning the extensive salmon fisheries of the Karluk River while the vessel was on her way to Unalaska. Mr. Alexander's report contains much valuable material on this subject, and is incorporated in the chapter on that region.

During the latter part of the season the progress of the work was much impeded by boisterous and stormy weather. The vessel arrived at Seattle, Wash., October 8. After docking the ship and making some minor repairs, San Francisco was reached November 2, where inquiries regarding their work were made among the officials of the various packing companies, the majority of those operating in Alaska having their main offices in San Francisco. On December 20 the *Albatross* proceeded to San Diego Bay to undergo a general refitting and overhauling. She was lying at this point at

the outbreak of the Spanish war, when, by order of the President, she was detailed to the Navy Department for use as an auxiliary cruiser.

Before proceeding to the report of the investigations, I desire to express my appreciation of the work performed by the officers of the *Albatross*, and of the courtesies extended by those interested in the canneries. Lieut. L. M. Garrett, U. S. N., besides carrying on his duties as executive officer, made all the observations for geographical positions. Lieut. H. E. Parmenter, U. S. N., in addition to his duties as chief engineer, conducted the field work of nearly all the surveys and plotted the work. Lieut. J. P. McGuinness, U. S. N., conducted the field work of several surveys, but was mostly engaged in examining salmon streams and lakes. Ensign Yates Stirling, jr., U. S. N., was employed in stream and lake examinations and conducted the hydrography. Ensign S. V. Graham, U. S. N., assisted in the surveys. Mr. A. B. Alexander assisted in the stream and lake examinations, and Messrs. F. M. Chamberlain and H. C. Fassett assisted generally, both rendering valuable service in photography. All performed their several duties in a commendable and satisfactory manner. The Alaska Packers' Association furnished me with a letter to all their canneries, directing the superintendents to offer the *Albatross* every facility for conducting the inquiries and examinations. All the other canneries also extended every courtesy, and at no place were any obstacles placed in our way.

For convenience, the salmon fisheries of Alaska may be divided into five districts, as follows: First, or southeast Alaska district, from the southern boundary to Cape Spencer; second, or Prince William Sound and Copper River district, from Cape Spencer to Cape Elizabeth; third, or Cook Inlet district, from Cape Elizabeth to Cape Douglas; fourth, or Kadiak and Chignik district, from Cape Douglas to Unimak Pass; and fifth, or Bering Sea district.

Considering the pack of salmon from 1878 to 1897, the percentage of pack in the different districts, as averaged from the tables, is approximately as follows:

Southeast Alaska (Lower, 15.0; Upper, 8.2)	23.2
Prince William Sound and Copper River	6.6
Cook Inlet	6.5
Kadiak (35.7) and Chignik (8.1)	43.8
Bering Sea	19.9
	100

As the redfish is the commercial fish, the other species being packed incidentally, or to fill up the quota when other kinds are scarce, no attempt was made to examine streams other than those having the red salmon, except when detained, or in localities where no positive information on the subject could otherwise be obtained. Reliable information relating to the streams is difficult to secure. There are large areas where not a single person can be found, except during the fishing season. Many hours were spent in Indian villages, surrounded by bucks and "klootchmen," children and dogs, tracing the geography of the country on the sand and trying to ascertain where the salmon streams of the vicinity were located, but generally without much reward. Their names for the different species of salmon are conflicting, and their geography vague and confusing. The largest species in a locality is always a "tyce." In many places they call the redfish "coho," and when it was intimated that the name was usually applied to the silver salmon, a quiet smile has been seen to pass around, expressive of our supreme ignorance.

Even when white men are met and questioned, information relating to the streams is difficult to obtain with any degree of exactness. The men at the head of the canneries know the cannery business thoroughly. They know how to get the fish to the canneries, pack them, case them for the market, and figure on the profits, but it is exceptionally rare to find one who has followed even his home stream to its source and examined the lake system and the spawning-grounds. This is not said in a spirit of criticism, for the cannerymen are interested only in obtaining fish, but to indicate the difficulty of gathering the information desired in our work, except by personal examination and investigation.

As the work progressed it was soon learned by certain signs, and independently of any information except by examination, whether a stream carried redfish. A shack near the mouth of the stream, with some fishing gear and a canoe or two housed in, was one sign, but it sometimes failed. A barricade, or the remnants of one at high-water mark in the stream, was an infallible sign of a redfish stream. Another sign was the color of the flowing water; if clear, it was probably not a lake outlet, and carried no red salmon; if but slightly tinged, brownish, not unlike the juniper water of the Dismal Swamp, it was a lake outlet, and probably contained redfish, and possibly all the other species as well.

The exploration of these streams and lakes is not an easy task. The bed of the stream is the only highway, and this taxes endurance to the utmost, and, at the best, progress is slow. The current is generally strong, the river bed is full of pitfalls, and after an advance of a mile, climbing over bowlders, crossing rapids, clinging to the shubbery growing on the faces of precipitous rock walls, and tumbling through trees and over log jams, one feels that certain muscles have been called into play that have never before been known to exist. Practically no advance can be made on the banks; here and there deer trails can be followed, but they lead off away from the course and into the mountains. The forest itself is almost impenetrable, not only on account of the vegetable growth, but because the mass of fallen and decaying timber and its débris form obstructions that are very difficult to pass. The parties frequently returned to the vessel well-nigh exhausted, and in several instances men gave out while on duty.

In carrying on the investigations the importance of obtaining detailed records from the different streams was recognized, not only to determine their capacity, but to be able to trace injury caused by traps, barricades, overfishing, etc. In a few instances only are complete records available, and even in these cases the waste at the fisheries and the amounts taken for local consumption and for winter food are unknown. The masters of cannery steamers in calling at the different fisheries record the number from each locality in a notebook when the fish are bought, and the amounts are paid upon delivery at the cannery. If the fish are obtained at fisheries conducted by the canneries, no accurate account is kept by localities. When the season is over and settlement is made, these memorandum books are thrown away or lost. Besides, there are frequent changes of masters, steamers, and cannery superintendents.

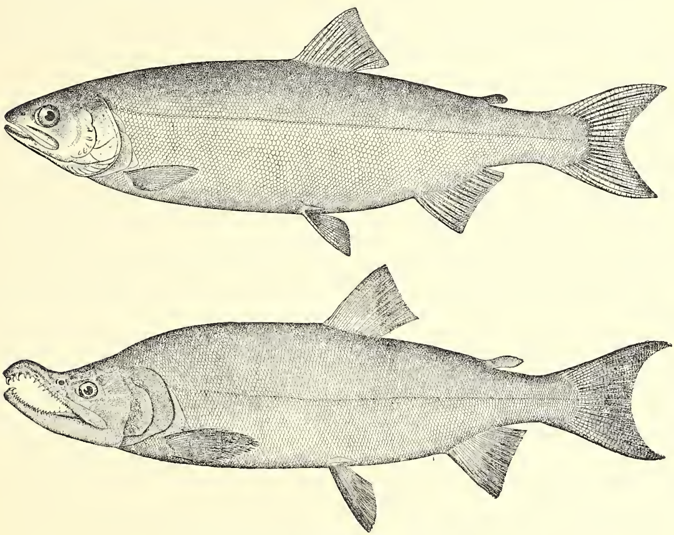
The Alaska Packers' Association now have printed form books at each cannery operated by them, in which are recorded, for each day, the state of the weather and the number of each species of fish received at the cannery and packed, so that at present the number of fish handled at any one of their canneries can be learned. If accurate stream records could be kept, it would be of great value, not only to the Government in framing laws, but to the canneries themselves.

PHOTOGRAPHING UNDER DIFFICULTIES, NEAR LORING.

THE SALMON OF ALASKA.

COMMON NAMES.

The salmon packed in Alaska consists for the most part of the species called "redfish" in that region (*Oncorhynchus nerka*), and referred to in this report by that name. It is known in other localities as blueback salmon, Fraser River salmon, saw-qui, sockeye, or saukeye salmon, and krasnaya ryba. Four other species are also packed, but they form only a relatively small portion of the output. Of these the principal species is the humpback (*Oncorhynchus gorbuscha*). The next important species is the coho (*O. kisutch*), also called the silver salmon, skowitz, hoopid salmon, bielaya ryba, kisutch, and quisutsch.



THE RED SALMON (*Oncorhynchus nerka*).

(Upper figure represents fish before entering river for breeding; lower figure represents breeding male.)

The king salmon (*O. tschawytscha*), which is by far the most valuable species in the Pacific States, is comparatively insignificant in numbers in Alaska. It is known in other localities as quinnat salmon, chinook salmon, Columbia salmon, Sacramento salmon, tyee salmon, saw-kwey, chouicha, and tschavitche.

The dog salmon (*O. keta*) is the least important of all the salmon of Alaska.

There are some local variations of the common names. At Hunter Bay the king salmon (*O. tschawytscha*) is referred to as "spring salmon." At Wrangell the redfish

(*O. nerka*) is called "silver salmon," and the coho (*O. kisutch*) is called "tyee." In Prince William Sound the small redfish are called "bluebacks" and the large ones "redfish." At Klawak and Sukkwan the coho is called "tyee," and at Killisnoo the same salmon is called "kluck."

RELATIVE IMPORTANCE OF THE SALMONS.

The salmon pack of Alaska, considered in the order of the market values per case of the canned fish, is made up of king, redfish, cohoes, and humpbacks; and, in the order of abundance for commercial use, redfish, humpbacks, cohoes, and king. It is said that there are more humpbacks in the streams of Alaska than redfish; and this is undoubtedly true in certain sections, such as southeast Alaska. In the opinions of the canners, with which I am in hearty accord, the coho should rank next after the king salmon in food value. Its meat is more delicately flavored and contains more oil than that of the redfish, but it lacks the full, deep, red color of the latter, which is popularly supposed to indicate the best quality of salmon. In reality, the redfish is coarse and dry compared to the coho.

The dog salmon are packed very sparingly; in fact, in only one cannery was this species utilized as such in 1897, and then only about 1,000 cases were packed. In another locality, in one cannery, a few humpbacks and dog salmon are packed together under humpback labels, and at nearly all canneries, where different species are packed, a straggling dog salmon, if in good condition, may be included; but as a rule dog salmon are not used, and may be considered a waste species.

The run of none of the minor species of salmon in 1897 outside of Bering Sea was very large, except that of humpbacks in southeast Alaska; the humpback, king, coho, and dog salmon figure only incidentally in the packs. A reference to the detailed output by canneries will make this clear. None of the canneries were able to handle the supply of humpbacks in 1897, and they were obliged to limit the catches. Of the total number of this species packed, 140,506 cases, or nearly 90 per cent, were credited to southeast Alaska. The waste was very large; not only were the canneries obliged to reject many fish, but at the fisheries double the number that could be sold were frequently hauled. At Fish Creek one seine haul contained 22,000 humpbacks. While there was an over-abundance of humpbacks, the redfish were very scarce, and the pack of this species is small compared to 1896, which was a good redfish year.

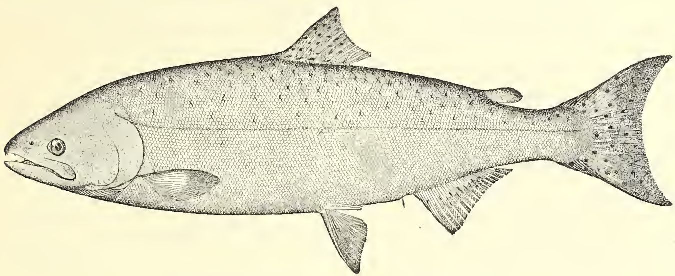
In 1897 the different species were represented in the pack as follows:

Species.	Cases (each consisting of 48 one-pound cans).	Percentage.
Redfish	688,581	75.74
Humpback	157,711	17.35
Coho	43,557	4.79
King	18,133	2.00
Dog	1,096	0.12
Total	909,078	100.00

THE SALMON RUNS.

In the detailed accounts of the different streams are given the times during which the various species of salmon run, based on the delivery of fish at the canneries. There is a great variation in the streams, but by referring to these records and to the table which gives the packs for the different canneries and the dates between which the packs were made, a fair idea may be obtained of the time when salmon run in sufficient numbers for commercial purposes. These dates vary greatly, but it appears as though the onshore movement came from the westward, the large rivers of a region receiving the first impulses. This movement is but natural when it is considered that the larger streams extend their influences wider and farther, and the fish naturally come first within the influence of these waters and follow them to their sources.

The king salmon, as a rule, probably come first; and, while not abundant at any fishing station in Alaska, they are found scattering everywhere, and individual stragglers occur in nearly every stream and throughout the entire season.



THE KING SALMON (*Oncorhynchus tschawytscha*).

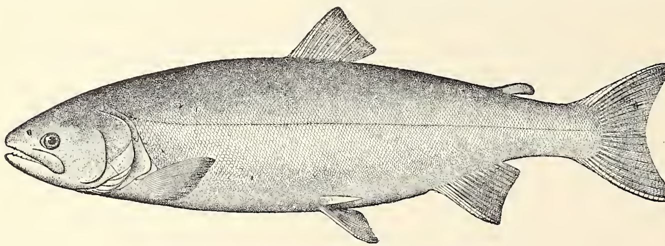
As soon as the ice clears sufficiently to permit fishing the king salmon are taken, the earliest at the Copper River about May 6, at the mouth of the Stikine River about May 15, while Cook Inlet and Taku River are not sufficiently clear until later—about May 25. In these localities a few redfish are taken with the earliest fishing, showing that they are present, and as soon as they run in sufficient numbers to fish for them the gear is changed, except in Cook Inlet, where king salmon are fished for until the latter part of July. The fishing for king salmon in other localities does not cease because fewer fish run, but because the run of redfish is much larger and the fishing more profitable. It is generally believed, and my observations confirm the view, that the king salmon run in numbers only in streams fed in part by glacial waters.

In different parts of this report, under stream or cannery headings, detailed reference is made to the runs of redfish, which need not be repeated here. In localities other than those in the vicinity of the larger rivers—that is, on purely redfish ground—it will be noticed that they run first in the Karluk district, where packing usually begins during the first days of June; Chignik follows about the middle of June, and Prince William Sound and southeast Alaska in the latter part of the same month. The streams nearer the sea receive the first fish, though there are many exceptions, as will be seen by reference to the stream notes. The run at Karta Bay, for instance,

which is well inside, and a long distance from the outside waters, is very early. There is a great variation in time even in adjoining streams; and while in some streams in southeast Alaska redfish run early—that is, before July 1—few canneries in that section begin to operate before July 1 to 7, and those that operate probably do not pay expenses; but they get their fisheries organized and the cannery in running order, and when the big runs commence they are ready for work. Pyramid Harbor and Wrangell, where a few king salmon are packed, commencing in May, should be excepted.

In southeast Alaska different streams are often referred to as "early" or "late" for certain species, and while there is undoubtedly some difference, and occasionally considerable, it is probably not so great as is often imagined. A stream having a large number of salmon will have the earliest arrivals in sufficient numbers to make their presence apparent, while a stream producing 5,000 to 10,000 will have so few early arrivals that they will not be noticed.

Except at Karluk, where the runs frequently extend to the first of October, and in the large rivers, the cannerymen usually count on about six weeks for the duration of the run of redfish; but if there is a variation in the time of commencing the run there is a still greater variation of time at the end, and in many localities much depends upon



THE COHO OR SILVER SALMON (*Oncorhynchus kisutch*).

the stage of water in the river. If the water is low, so the fish can not ascend, they are held in the salt or brackish water and do not seem to ripen so rapidly, but if there is sufficient water they do not remain around the mouth of the river very long, but pass rapidly to the lakes.

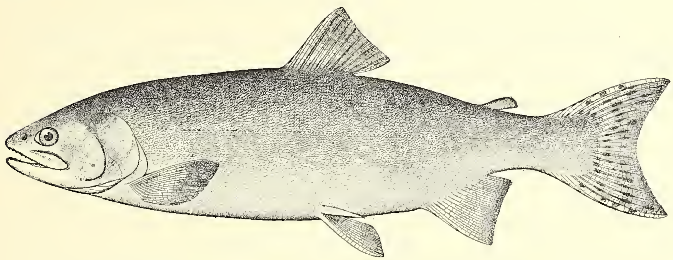
The bulk of the redfish pack is made in July and the early part of August, though most of the canneries pack until the latter part of August, and some into September, but except at Karluk these are only a few fish that are taken in connection with the humpbacks and cohoes, which then form the body of the pack.

Cohoes are not plentiful anywhere in Alaska. Those from the streams on the mainland are said to be larger than those from the island streams. The run for commercial purposes commences the first week in August and continues until after the canneries close, September 20. There is, however, the same variation in the runs of cohoes as noted for redfish. The cannery at Wrangell, which packs cohoes from Lake Bay, usually commences canning the first week in July; at Tolstoi (Thorne Bay) the fish run nearly at the same time, but these are unusually "early" streams; as a rule, they are in other localities from three to four weeks later, though scattering fish are taken throughout the season.

HUMPBACK SALMON FROM STREAM AT HEAD OF UGANUK BAY.

Humpbacks may be said to run in southeast Alaska, where the principal pack of humpbacks is made, from July 15 to August 15, though some years they may be a week earlier, and at some canneries these fish are packed until September 1. In Prince William Sound they seem to be about a week earlier. It is said that they are in good condition for packing only about one month. Late in the season the meat seems watery, and it is difficult to prepare a can of full weight.

Dog salmon are not very numerous, and as they are not used for commercial purposes no record concerning their run is available. At Chignik in 1897 the run was at its height August 1, forming at that time 5 per cent of the catch; at Uganuk, Kadiak Island, the fish were dead and dying in the streams on August 12; at a cannery in southeast Alaska a few were packed from July 17 to August 6; at Hunter Bay the run is said to last from August 1 to October 1, which is doubtless an error; at Tolstoi it is said they run with the humpbacks, which is probably more nearly correct. They are, however, taken scatteringly throughout the season. Along the Alaskan Peninsula and the Aleutian Islands they are preferred by the natives for their winter supply of "ukali."



THE HUMPBACK SALMON (*Oncorhynchus gorbuscha*). Sea-run.

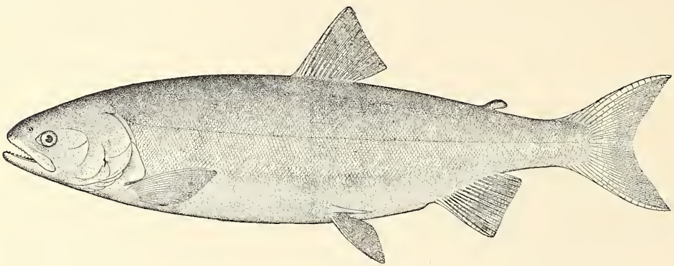
No definite information about steelheads was obtained. They are nowhere very abundant, are not used except for local purposes, and probably run when the canneries are closed. At Ketchikan it is said they run from the middle of May to the last of June, though some seasons they are seen as early as the middle of April. At Tolstoi it was claimed they run from November to April, but are taken about every month in the year in various conditions of spawning.

SPAWNING AND OTHER HABITS.

Little is known of the sea habits of salmon, and it may therefore seem useless to speak in this report of beliefs and impressions which have been acquired in various ways and through different agencies. It is quite generally supposed that salmon return to the streams in their fourth year, and that they run to the same waters in which they were hatched, but these theories are questionable. Fishermen state that every four years there is a big run of fish and cite one or two instances to prove it, but this will stand little investigation. If the four-year theory were correct, the progeny of the big runs would return fully matured four years from the time the parent fish entered the stream to spawn. The fish that enter the streams

during the summer months spawn late that summer or during the fall. In some instances the redfish spawn until Deeember, and other species later. In the cold waters of autumn it is at least four months, and usually longer, before the fish is evolved from the egg and has absorbed the egg-sac. It is probably spring or early summer before it is a free swimmer and takes food of its own eapture, and it is quite certain that nature has not endowed it sufficiently at this time to take care of itself in the open sea. So far as ean be learned, it is a year from this time, or the following spring or summer—two years from the time of the arrival of the parent fish—before the young proeeed to salt water, and they are then 4 or 5 inches long.

It is no doubt true that many salmon less than a year old find their way to the sea, but they probably have been swept from the breeding-grounds by currents or other adverse conditions, and have not proceeded to the salt water by their own volition.



THE DOG SALMON (*Oncorhynchus keta*).

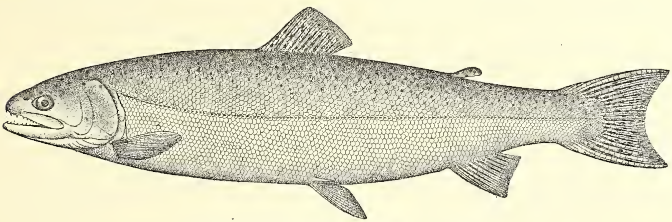
At Klawak it was learned that in early spring there are two sets of salmon in the lake—one about 4 inches long and another about 1½ inches long. After the iee leaves the lake and river the larger ones move downstream to the mouth, where they remain for some time and ean be seen in very large numbers, all the species that run in the stream being represented. Mr. J. C. Callbreath has made the same observation in his hatchery work in Alaska, and has also notieed the cannibalistic tendency of the older fish. He therefore places the output of different years in separate lakes.

It is probable that the young salmon in passing to the sea remain near the edge of the eontinental plateau until they mature, and it is also probable that all fish of the same speeies do not arrive at maturity at the same age; in other words, the fish from the same spawning do not all mature the same season. In nearly all the streams that have runs of red salmon, numbers of small but fully matured fish of the same speeies are found, and it is said these are all males. In the lake at Klawak were seen some of these small salmon, from 1½ to 2 pounds in weight, that had spawned. Some were alive, but in the last stages, and others were dead on the beaeh—all red-eolored, hook-jawed, and emaeiated. At Chignik there are so many of these small fish that they are ealled by a different name—"Arctic salmon." Referenee is elsewhere made to the very small mature redfish that run at Necker Bay. These may all be young fish that matured early and before others of the same output, or they may represent a raee of dwarfed redfish, sueh as are found in the lakes of Idaho and Washington.

In conversation with cannerymen it was found that those who appear to have paid some attention to the matter place the age of large, matured salmon much higher than the four-year theory warrants. Usually, when asked the question, the more intelligent state that, in their opinion, the fish are from 8 to 10 years old, but of course this is a matter of conjecture.

The spawning-ground sought by salmon is a sandy and gravelly bottom in a pool or eddy where the water is 2 to 3 feet deep, but this is not always attained. The redfish is probably the most fastidious in its selection, and after the redfish is the coho; the dog salmon and humpback spawn anywhere.

It is well known that the redfish enters only those streams that are lake outlets, and it is generally believed that it does not spawn in the lakes, but always in an entering stream. Elsewhere in this report it has been shown that this is not always the case. Usually the lakes are deep and have little shore shelf, so that the fish enter the inflowing streams where the proper depth and bottom is found; but when the lake is properly conditioned, has a sandy or gravelly bottom, gradually shelving, the redfish will spawn in it, though they undoubtedly prefer the conditions usually presented by an inflowing stream.



THE STEELHEAD (*Salmo gairdneri*). Adult.

When the fish are ready to spawn they excavate a nest by plowing up the sand and gravel with the nose and sweeping it out with the tail. The nests are sometimes 3 feet in diameter and 12 to 18 inches in depth. The female then deposits the eggs, which are quickly covered with the milt of the male. The eggs usually fall and lodge between the gravel on the lower side of the nest and are covered by the same process as adopted in building the nest. The parent salmon remain near the nest and fight off all intruders as long as they can maintain their position, becoming more and more emaciated and finally dying. Mr. Miller, of Klinkwan, who has lived in Alaska for some twelve or fourteen years and has noticed their habits, states that the red salmon spawn within six weeks to two months after they enter the streams, and he has observed them spawning until November, and occasionally even until December, under the ice. The eggs deposited late do not hatch out for three or four months, and early in the spring the young with the sac could be seen by taking up a handful of gravel from the bottom. Upon being released they wriggle back and burrow in the gravel again. He states that the young fish do not become free swimmers until some time after they are hatched; they dodge around under stones and sticks, come to the surface and nibble at some passing object, and dart back again. This is usually in the spring, and he states that they remain in the lake until the following spring and

that they then return to the sea. This information, he says, he obtained from personal observation.

So far as known, observations have not been systematically made on the natural spawning habits of the salmon in Alaska, and only on rare occasions has anyone been met who had ever observed salmon spawning there. The cannerymen are in the country for fish and not for investigation or scientific research. Very few have ever even seen the lakes supplying the streams from which they obtain their supply. In the fall the canneries are closed and left in charge of the watchmen, and they, with the white stragglers who remain around, probably hibernate. At any rate, they think no more of salmon until the next packing season commences.

Reference has been made chiefly to the late-spawning fish. While it is probable that many of the fish remain in the fresh water for six weeks or two months before spawning, others are more advanced and spawn soon after their arrival. The manager of Yes Bay cannery states that he has seen young salmon with the egg-sac attached as early as the middle of September. Mr. Bell, who has been a permanent resident of Alaska for a number of years, and who has been superintendent of a cannery and now owns the saltery at Tolstoi (Thorne Bay) where he lives, says that in the late fall he has observed large numbers of very young salmon in the lakes; that he has frequently watched the spawning fish, and that rarely are the male and female ready to spawn at the same time, and the one that is delayed will beat itself on the bowlders or gravel apparently to hasten the ripening. He further states that in many instances they are unable to void the spawn, and both male and female die before their natural functions are fulfilled, he having frequently cut open the dead swollen fish on the shore and found the eggs or milt in them.

Mr. Callbreath refers to this subject with a similar experience, and I have seen the same with dog salmon.

Mr. Bell, in speaking of humpbacks, remarked that he had seen a number spawn in the same nest, others in brackish water, at high tide, and when the nests were uncovered at low water the sea birds consumed their eggs, and that he had observed well-filled nests destroyed and the eggs thrown out by other humpbacks that had selected the same place for their nests.

At the head of the south arm of Uganuk Bay, Kadiak Island, is a stream having dog salmon and a few humpbacks, on which I spent a day, August 11; a description of it may give some idea of the appearance of these streams during the spawning season. The following is quoted from field notes:

Left the ship at 6 a. m. on a general reconnaissance. Passed down South Arm, which we found to be a straight, apparently clear body about 5 miles long and an average width of not much less than a mile. At the head of the arm is a flat, through which flows a small stream about 20 feet wide. It was low water, and we landed on the edge of the flat and followed the stream a few hundred yards, where it passed between two high rocky bluffs, probably a hundred yards apart. Inside this passage a large tidal basin opened, about 1½ miles long by 1 mile wide, which at low water is a great mud and gravel flat with the stream flowing through it by several channels, and at high water is covered with 6 or 8 feet of water. At the head of the basin the stream empties between grassy banks that are low and extended for some distance, with here and there a scrub growth. Over the grass plain bordering the river, the bear trails were as thick as the lines on a checker-board, and in many places close to the water the grass was beaten down and the bones and half-consumed fish plainly indicated the presence of bears.

At the mouth of the river we first encountered the ascending salmon; they were mostly of the dog species, all barred, though a few humpbacks were present. As we advanced they increased in num-

LAKE, WEST BRANCH OF SKOWL ARM, LOOKING UP

SPAWNING BEDS IN STREAM, SKOWL ARM, KASAAN BAY.

bers until it seemed as though in places one could no longer advance through them. It was simply full of dog salmon in all stages, from those in but a short time from the sea to the spent and dying. There were thousands upon thousands of them and other thousands dead on the banks or floating down with the current. They struggled over riffles only a few inches deep and when disturbed dashed about, frequently throwing themselves bodily on shore. We followed the stream about two miles and it seemed in places as though we were wading in salmon; they would often strike one's leg with considerable force, swim between one's feet, and in walking we at times stepped on them, and frequently touched them with the foot. But what a change had come over these fish from the time they first entered! Those that were spent, and some that had not spawned, were in all stages of decay, repulsive-looking objects, all dying, some in their last struggles. The flesh of many was deeply gashed as though decaying, the fins frayed and torn, the skin gone in places showing dirty and sickly-looking yellow flesh, skin hanging in shreds from the head, jaws heavily hooked in the males, teeth prominent, body thin and emaciated. The water was polluted and had a bad smell which was intensified by the stench from the decaying salmon on the beach. Those in the last stages when turned over had hardly the strength to right themselves. I had my trout gear with me and there were plenty of trout hanging around the salmon, the more vigorous of which, divining their purpose, would frequently dart at them, but the sight of the fish and the stream quelled my fishing ardor and the gear was not put in service.

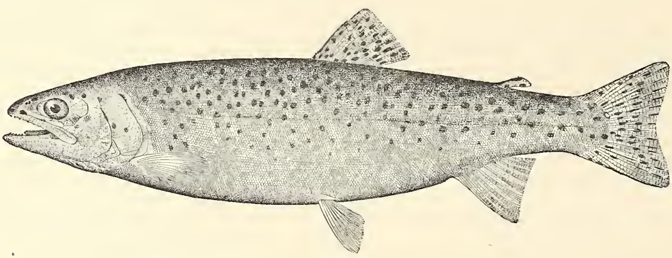
We kicked a large number of salmon out on the banks and hooked others out with sticks, and examined them. My first surprise was that the males were largely in excess, and whatever the condition, with few exceptions, even those nearest death had milt. Of the females, the greatest number were full of eggs, separated and ready to flow, not only those that were still vigorous, but including many in the last stages, fish that certainly no longer had strength for nest-building. These fish when kicked out would void some of their eggs, and when pressed along the belly would shoot their eggs in great jets. In a few instances we found dead fish on the banks that had spawn in them. I did not understand these conditions then and do not now. My impression was that the salmon arrived on the spawning-ground in ripening condition, performed its natural function, declined, decayed, and died. But here were fish, and many of them not more than a few days, some indeed hours, from death, that were full of spawn. They were on the spawning-ground, for the bottom of the stream was in holes and ridges, made so by the nests.

On August 25 I spent a day on a humpback stream in Prince William Sound. The stream is a very small one, not more than 15 feet wide, and did not carry much water, though there were many deep pot holes. This stream, in places, seemed to be packed solidly with humpbacks, all struggling to ascend. In places where the water flowed over riffles, not over an inch or two deep, they seemed to rise out of the water and would wriggle, moving rapidly, for a distance of 10 to 15 feet, until deeper water was reached. At the mouth of the stream I kicked out 40 or 50 fish and examined them. The males were hook jawed and humped, but all were bright-colored and vigorous fish; yet upon pressure the milt flowed readily in the males and the eggs were separated in the females, some of the eggs being voided in landing on the banks; yet these fish were evidently just entering the stream.

Near the head of the stream I was much interested in observing the spawning. A female was over a so-called nest, which was an excavation in the gravel, of apparently rounded form and quite large—I should say nearly 4 feet in diameter and 18 inches deep. The female remained over the nest, but occasionally turned from it to drive off what seemed to be one of her own sex; the favorite male was near by, but he was more busily employed in keeping at a distance a number of male intruders. This male every minute or two would rise to the surface, and half out of the water would flap sideways on the surface as if beating the water; at other times he would descend to the bottom and seem to chafe his belly on the gravel. A small pebble thrown in the water did not disturb them, but a larger stone thrown with a splash over the nest sent all scurrying away, the female darting back very warily after a few minutes and

occupying her place over the nest, followed later by the male. At a second nest a female held the position against all intruders, male or female; any fish approaching within 6 feet was attacked.

Cannerymen and fishermen in Alaska all agree that hardly any two streams in the Territory carry exactly the same redfish or other species of salmon, but the redfish is the only one that receives much attention, the others being taken incidentally. It is said that there is a slight difference in general form, color, and texture which fishermen recognize, as well as a large difference in weight. Upon this hangs the idea persisted in by many fishermen, that salmon do return to their parent stream; and if the differences mentioned do exist, the theory based upon them must have great weight. I have never been able to detect the variations in form, etc., except the well-known changes which take place in each fish from the time it arrives from the ocean until death overtakes it on the spawning-grounds, but there seems to be a difference in the quality, fish from certain streams being considered better than others. For instance, the best redfish in Alaska are said to be the Chilkat redfish, in that they are more delicate in flavor and more oily.



THE RED-THROATED TROUT (*Salmo mykiss*). Adult.

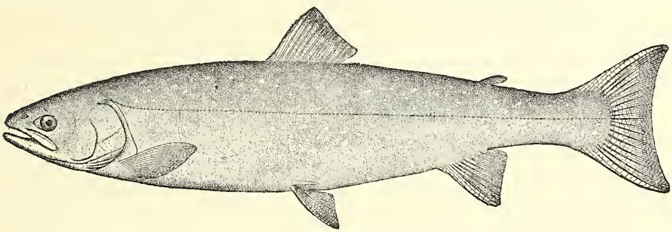
There are undoubted and undisputed differences in average weight, and so well known is the weight of redfish that run in different streams that contracts are made and prices paid accordingly; for while the number of fish required to pack a case varies, it practically remains the same for each stream from year to year.

As extremes of weight, it may be mentioned that Quadra stream carries 8-pound redfish, while Necker stream (about 35 miles south of Sitka, on Baranof Island) has redfish averaging about 2½ pounds in weight. These are not accidental runs, but people who have fished these streams for years assert that each year these streams have the same fish with little or no variation. It is probable that the fish vary more in the same stream than is stated. At Karluk the early run usually consists of fish from 14 to 15 and even as high as 17 to the case, but as the season advances they come down to 12.

At all places visited by the *Albatross* inquiries were made as to whether spent salmon had ever been seen returning to the sea, and the usual reply was that, with the exception of king salmon and steelheads, they all died at the headwaters after spawning. Some of the cannery superintendents whose opinions were obtained had fished in Alaska twelve to fifteen years; others were men interested in the fish-

eries who had lived permanently in Alaska for ten or more years. In one instance a canneryman had set nets to take returning spent salmon, but never caught a single fish. At the office of the Alaska Packers' Association, in the presence of six or eight cannery superintendents, the same question was propounded, when one of them, from a Bering Sea cannery, said he had seen spent salmon returning to the sea. Upon closer inquiry, however, it was learned that the current at this locality was very strong and had swept the weakened and emaciated fish down, but that they were heading upstream. I have personally seen both humpback and dog salmon swept downstream by the current to salt water, but they died, nevertheless. I have no doubt that all species of salmon, except some king salmon and steelhead trout, die after spawning, and I believe that if directly after spawning they were transferred to salt water they would also die.

One of the greatest sources of destruction to the redfish, and, in fact, to all salmon, are the trout, both the Dolly Varden (*Salvelinus malma*) and the cut-throat (*Salmo mykiss*). Early in the spring, or shortly before the redfish commence to run, the Dolly



The Dolly Varden Trout (*Salvelinus malma*).

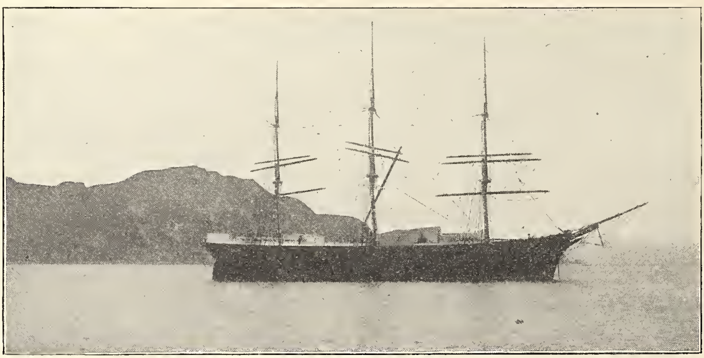
Varden comes to the mouth of a stream and awaits the salmon, and about the same time the cut-throat comes down the stream to brackish water to welcome the new arrivals; together these two follow the salmon to the spawning-beds. The Dolly Varden is usually found wherever the salmon is, of whatever species; the cut-throat more rarely. On the spawning-grounds, when the ripe fish deposit their eggs, the trout consume them in immense numbers. The Dolly Varden has been seen to take the salmon eggs as they were dropped. The salmon know these egg destroyers and will frequently dart at the trout, but the latter are quicker in their movements and get away without injury.

The next great destroyer of the redfish eggs is the humpback salmon. When these fish have access to the redfish spawning-grounds, they will spawn over the redfish nests. The humpback arrives later than the redfish, and in building its nest the redfish eggs are flung about, disturbed, and destroyed. Usually humpbacks are present in nearly all streams, though they can not ascend some that are open to redfish, because the latter are more vigorous and can surmount obstacles that the former can not. In such cases the humpback spawns in the lower courses of the stream in pools and eddies—in fact, often in brackish water and on banks of sand and gravel that are exposed at low water, where the eggs are of course lost.

ESTABLISHMENT OF SALMON CANNERIES IN ALASKA.

As it will be necessary in this report to refer frequently to the commercial organizations doing a salmon-packing business in Alaska, it may not be out of place here to give a short account of the growth of this industry, in order that the references may be properly understood, although an account of each cannery will be hereafter given.

The first canneries in Alaska were at Klawak and Old Sitka, both built in the spring of 1878. At the former place the North Pacific Trading and Packing Company erected their plant, made a pack that year, and have done so every year since. At the latter place the Cutting Packing Company commenced operations, and, after making two packs (1878 and 1879) the cannery was closed. In 1882 its available machinery was moved to Cook Inlet by the Alaska Packing Company of California, and there utilized in a cannery built that year at Kussilof, now known as the Arctic Fishing Company.



Transport ship at Chignik.

No additions were made to the Alaska canneries until 1882, when the cannery just mentioned was built and the first cannery on the Karluk River appeared, built and operated by Smith & Hirsch, and now known as the plant of the Karluk Packing Company.

The year 1883 saw three additions—Pyramid Harbor Packing Company, Chilkat Packing Company, and Cape Fox Packing Company, all in southeast Alaska. In 1884 the first cannery in Bering Sea, the Arctic Packing Company, on the Nushagak River, commenced operations, followed in 1886 by the Bristol Bay Canning Company and the Alaska Packing Company, both at Nushagak. In the year 1887 one more cannery was added to the list, that of the Aberdeen Packing Company, on the Stikine River, in southeast Alaska. During the same year the plant of the Cape Fox Packing Company was moved to Tongass Narrows and operated under the name of the Tongass Packing Company.

CANNERY AT BOCA DE QUADRA.

SALMON SALTERY ON THORNE BAY.

In 1888 the following additional canneries were in operation: Alaska Salmon Packing and Fur Company, at Loring, southeast Alaska; Cape Lees Packing Company, at Burroughs Bay, southeast Alaska; Northern Packing Company, at Kenai, Cook Inlet; Kodiak Packing Company and Aleutian Islands Fishing and Mining Company, both at Karluk, Kadiak Island; Arctic Packing Company, at Larsen Bay, Kadiak Island, and the Nushagak Packing Company, on the Nushagak River, Bering Sea.

The increase of canneries in 1888 and their large output called the attention of the public to the Alaska salmon fisheries, and in 1889 there was a further increase of canneries, as follows:

Southeast Alaska: Boston Fishing and Trading Company, Yes (McDonald) Bay; Baranoff Packing Company, at the Redoubt, near Sitka; Astoria and Alaska Packing Company, Freshwater Bay; Bartlett Bay Packing Company, Bartlett Bay, and Chilkat Canning Company, Chilkat Village.

Prince William Sound and Copper River: Peninsula Trading and Fishing Company, Little Kayak Island; Central Alaska Company, Little Kayak Island; Pacific Packing Company, Eyak, Copper River, and the Pacific Steam Whaling Company, Eyak, Copper River.

Kadiak and Chignik: Hume Packing Company, Karluk; Alaska Improvement Company, Karluk; Arctic Packing Company, Alitak Bay; Kodiak Packing Company, Alitak Bay; Royal Packing Company, Afognak Island; Russian-American Packing Company, Afognak Island; Chignik Bay Company, Chignik Bay; Shumagin Packing Company, Chignik Bay; Chignik Bay Packing Company, Chignik Bay; Western Alaska Company, Ozernoi, Alaska Peninsula; Thin Point Packing Company, Thin Point, Alaska Peninsula.

The cannery of the Alaska Improvement Company, at Karluk, was built and ready for operation in 1888, but the loss of the *Julia Ford*, the cannery ship, with all the season's outfit on board, kept the cannery closed, and the first pack was therefore made in 1889.

In 1888 there were 17 canneries in operation in Alaska with an output of 412,115 cases, and in 1889 there were 37 canneries with an output of 714,196 cases. Two more canneries were added to the list in 1890—George W. Hume, at Kussilof, Cook Inlet, and the cannery of the Metlakahtla Industrial Company, in southeast Alaska. In 1891 only one new cannery, that of the Bering Sea Packing Company, at Ugashik, Bering Sea, was added, while several operated the year previous were closed, and in a few other cases there was a consolidation of interests. In 1892 and 1893 there was a further consolidation of cannery interests, and in the latter year one additional cannery was operated, that of the Hume Canning and Trading Company, in Tanglefoot Bay, near Karluk. There were no new canneries built in 1894, but in 1895 two more were in operation at Naknek, in Bering Sea, the Arctic Packing Company and the Naknek Packing Company.

In 1896 the following new companies were in operation:

Southeast Alaska: Quadra Packing Company, in Mink Arm, Boca de Quadra; Pacific Steam Whaling Company, Hunter Bay.

Kadiak Island: Uganuk Fishing Station, Uganuk Bay.

Alaska Peninsula: Hume Brothers & Hume, Chignik Bay; Pacific Steam Whaling Company, Chignik Bay.

Bering Sea: Point Roberts Packing Company, at Koggiung, Kvichak River; Ugashik Fishing Station, Ugashik River.

In 1897 two more canneries were added—Hume Brothers & Hume and the Pacific Steam Whaling Company, both at Uyak Bay, Kadiak Island.

The foregoing account gives briefly the dates of the building of the canneries in Alaska. After 1891 several of the canneries were consolidated, a few were burnt, some were dismantled, and the available machinery utilized in the construction of plants in more favorable localities, and in some instances the sites were entirely abandoned. The large increase in canneries in 1888 more than doubled the pack for that year over that of 1887, and the addition of twenty more canneries in 1889 increased the pack for that year and for the two years following to nearly double the quantity packed in 1888. The market became glutted, and in order to reduce the output a consolidation of interests followed. This was not very difficult, as a few individuals controlled a large number of the canneries. One firm in San Francisco alone controlled six canneries, with an output in 1889 of 155,118 cases; others controlled several.

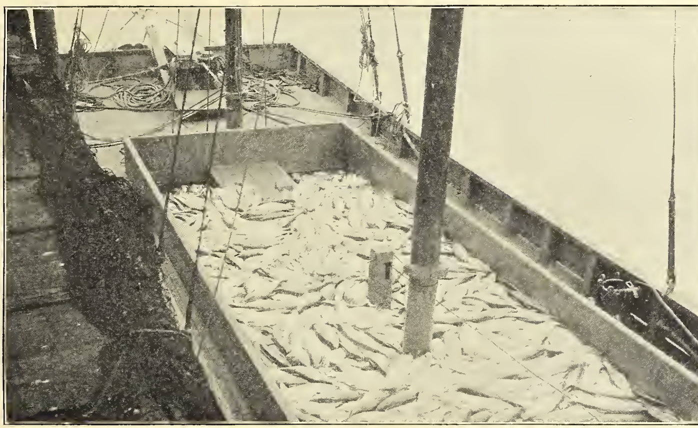
Cannery at Chilkat.

In 1890 the three canneries at Chignik combined under an operating agreement known as the Chignik Bay Combination, under which the plant of the Chignik Bay Company was operated, the three canneries sharing the expense and dividing the output equally. This arrangement remained in force during the seasons of 1890 and 1891. Its evident success in 1890 probably led to the local combinations on Kadiak Island in 1891, and then to the association which now exists.

The large packs during this period and the glutted market caused the cannery interests to devise some scheme to meet the conditions. The combination at Chignik in 1890 permitted the pack to be made there at a lower rate and, as previously stated, it was continued in 1891. The same year (1891) the canneries at Karluk, Uyak, and Afognak entered a combination under the name of the Karluk River Fisheries, under which it was agreed that each cannery should have a quota of fish from the several

localities, based upon the average packs of each cannery in 1889 and 1890. The estimated pack for the canneries interested was placed at 250,000 cases, and upon this estimate the apportionment of the work at each cannery was made. Under this agreement four of the eight canneries were closed, their quota being packed in the other four canneries as follows, viz, that of the Royal at the Karluk, of the Arctic at the Kodiak, of the Aleutian Islands at the Hume, and of the Russian-American at the Alaska Improvement.

In the summer of 1891 the Kodiak Packing Company* and the Arctic Packing Company, both at Alitak Bay, also had a mutual agreement under which only one cannery, the Arctic, was operated, the quota of fish of the Kodiak being packed in the Arctic cannery. By these combinations the full pack of the Karluk district was made in half the number of canneries and the expense of packing very considerably reduced.



Fish scow at dock, Chignik.

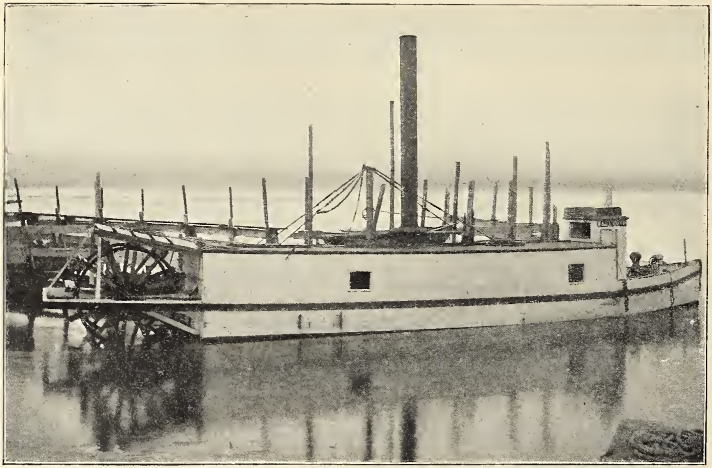
In September, 1891, the Alaska Packers' Association was formed to dispose of the unsold salmon of that season's pack (some 363,000 cases), and five trustees were appointed to manage the business. This association was not incorporated, and expired after the salmon were sold.

The successful operation of these arrangements led, in 1892, to an arrangement in which nearly all (thirty-one) of the canneries joined, entering under the name of the Alaska Packing (not Packers') Association, for the purpose of leasing and operating and therefore controlling the canneries and reducing the Alaska pack for that year, it being found too great for the market's demands. All the canneries in operating condition in 1892 were members of this association except the following, viz: Met-

*Though the present approved spelling of the name of this island is Kadiak, the company retains the former spelling Kodiak.

lakahtla Industrial Company, at Metlakahtla; Boston Fishing and Trading Company, at Yes Bay; Baranoff Packing Company, at Redfish Bay; Chilkat Canning Company, at Pyramid Harbor; Alaska Improvement Company, at Karluk, and the Bering Sea Packing Company, at Ugashik.

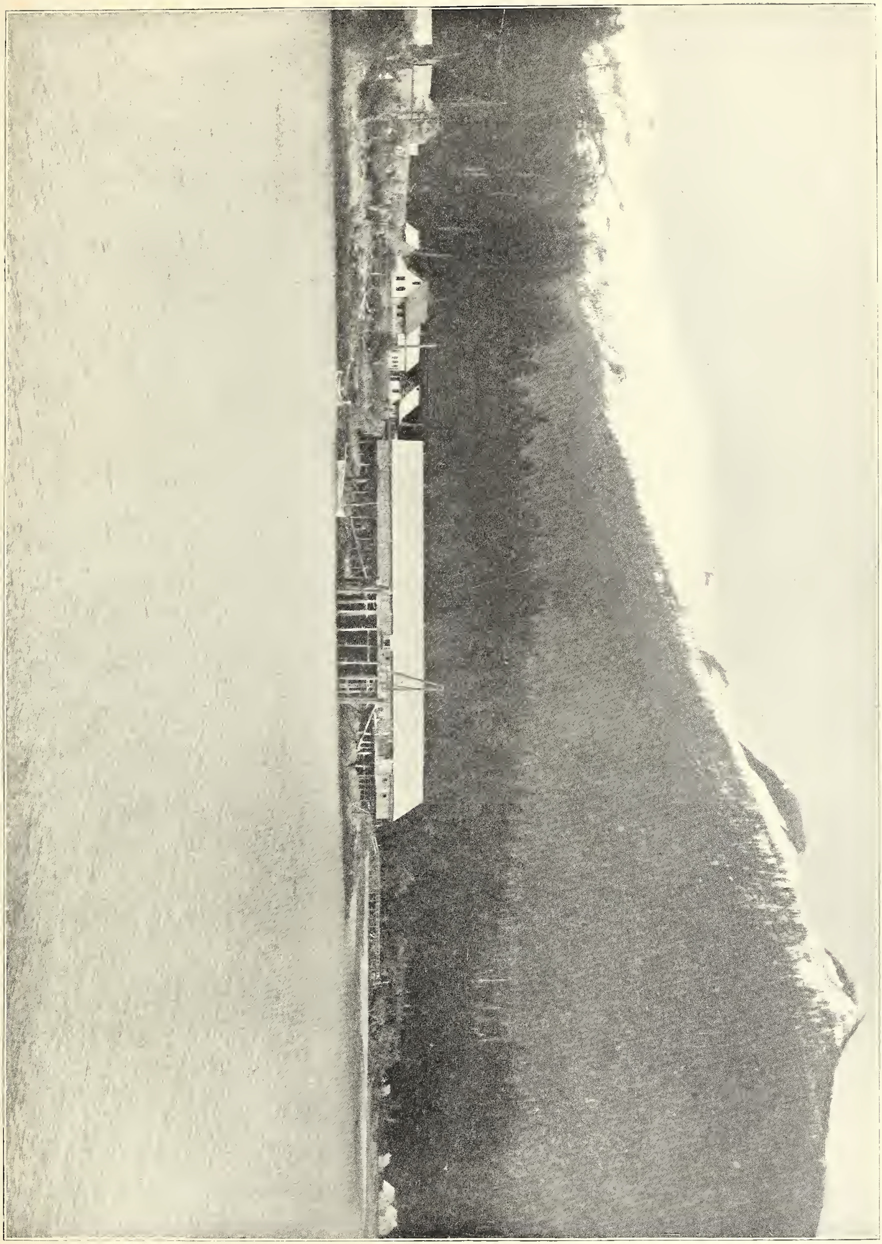
The association was regularly incorporated on January 13, 1892, and shares were distributed on the basis of one for each 2,000 cases packed in 1891, and the profits were divided equally on all shares regardless of the amount of profits derived at the different points. Of the 31 canneries, 9 were operated by the association, while the others were closed, the Alaska pack being reduced one-half.



Stern-wheel steamer used in towing fishing boats and setting nets, Chignik.

The year 1893 found the Alaska Packers' Association organized and incorporated (February 9). This association was formed from the canneries that had joined the Alaska Packing Association of 1892, except the Pacific Steam Whaling Company, at Prince William Sound, and the Peninsula Trading and Fishing Company, the latter's cannery having been moved from Little Kayak Island to the Copper River Delta in 1891.

The agreement of 1893 was similar to that of 1892, except that the amount of profit was taken into consideration, in addition to the probable average quantity which could be packed at the different points. This was subject to adjustment for each district and no arbitrary rule was followed. Each cannery entering the association was obliged to purchase an additional amount of stock equaling two thirds of the number of shares received by it for its plant; that is, a company which received 1,500 shares for its plant was required to purchase 1,000 shares additional. The money received from this sale of extra stock was used as working capital. No shares were sold to the general public, the owners of canneries subscribing for the full amount.



SALMON SALTERY, KETCHIKAN.

The Alaska Packers' Association is the largest canning operator in Alaska. Of the 29 canneries operated in 1897, 17 belonged to this association, with an output of 669,494 cases, or nearly 74 per cent of the total pack, while the other 12 canneries packed 239,584 cases, or 26 per cent. In addition to the 17 operating canneries the association had as reserves 8 other establishments, besides several in a dismantled condition which have not, however, been abandoned.

The Pacific Steam Whaling Company has increased the number of its canneries during the past two years. In 1889 the company built and operated a cannery at Eyak, Prince William Sound; in 1893 it controlled the plant of the Peninsula Trading and Fishing Company in the Copper River Delta. In 1896 it built and operated a cannery at Hunter Bay, in southeast Alaska, and another at Chignik Bay, Alaska Peninsula. In 1897 a cannery was built and operated in Uyak Bay, Kadiak Island, and cannery buildings were erected at Kenai, Cook Inlet. Machinery will probably be installed in the latter ready for operation in 1898.*

SALTING SALMON.

Redfish are salted only in localities like Bristol Bay, where a large run sometimes taxes the cannery facilities, when the surplus is salted, and at Egagak (Bering Sea) and Tyonek (Cook Inlet), where the run is not large enough to maintain a cannery. A few king salmon are salted for private use at canneries where stragglers are taken in the general catch, and at places like Killisnoo, where a little salting is done on special orders.

The commercial salting outside of Bering Sea consists chiefly in whole cohoes and humpback bellies. In the latter the number varies according to the cutting. One saltery (Ketchikan) delivered humpback bellies under contract to a cannery at $3.25 per half barrel, and tried to cut 160 bellies to that measure. This product should reach retailers on the Pacific coast at, say, $5, and if sold at 5 cents per belly would bring $8, making a good profit for the venture and a cheap fish for the consumer.

It is very difficult to obtain accurate saltery statistics. The low price of salt salmon, and the terms offered by the canneries in the purchase of fresh fish, have induced the men formerly engaged in salting to sell their fish fresh, the cannery tender calling for them, and to salt only those that are not called for in time, or the surplus in the event of a large run. Small schooners frequently move from one stream to another when the run is small and salt a few fish on board. It is doubtful if there are more than three or four salteries in Alaska, outside of Bering Sea, that are conducted purely as such, and these are in remote places where the catch is uncertain or it is inconvenient for the cannery steamer to call; the others are operated only to make use of the fish not sold fresh.

On account of the variation in the weight of the same species it is rather difficult to give even an approximate estimate of the number of live fish necessary to make a barrel of salt salmon, but the following may give a general idea of the subject: A barrel of salt fish contains 200 pounds of fish washed from the salting tub; 1 barrel of redfish has from 40 to 52 fish; cohoes from 25 to 35; humpbacks, from 70 to 80; king salmon, from 10 to 14. A barrel of humpback bellies represents from 300 to 320 fish.

* The machinery was installed and the plant operated in 1898.

FISHERY AND CANNERY METHODS.

THE FISHERIES.

The methods employed in taking fish at the fisheries are given in detail in the descriptions of the canneries and streams, and will only be briefly referred to here. Each locality has its own methods, obtained by experience and believed to be the best. In general it may be said that in localities where the water is discolored gill nets are used, and if the topographical conditions are favorable traps are added; where the water is clear, drag seines give the best results. In southeast Alaska drag seines are used exclusively except at Chilkat and Wrangell. Drifting gill nets are used in Chilkat Inlet and at Taku by the cannery fishermen, while the Indians use small nets and gaffs in Chilkat and Chilkoot rivers, as described under other headings. The cannery at Wrangell uses gill nets in the fisheries at the mouth of the Stikine, but all fish obtained for this cannery in other localities are taken in drag seines. Spasmodic attempts have been made to work traps in southeast Alaska, but the results have not warranted the expense. Gill nets and purse seines have been tried in the lower section, but with indifferent success.

The canneries in Prince William Sound fish the Copper River delta with drifting gill nets, and the Prince William Sound streams with drag seines. In Cook Inlet the fishing is done with drifting gill nets, and by traps at prominent points along the shore leading to the rivers, and in the mouths of the rivers.

On Kadiak Island drag seines are used—a description of which will be found in the report—though gill nets have been experimented with, and for several years huge floating traps have been tried at Uganuk. The fishery at Chignik is carrried on principally with traps, but drag seines are also used and formerly gill nets, but these are not much in vogue now. In Bering Sea the fish are taken in gill nets and traps.

Outside of southeast Alaska the fishing is carried on entirely by the canneries; that is, when the cannery ships proceed to their stations in early spring they carry fishermen with whom contracts have been made for the season. Occasionally fresh fish are bought from the natives; but there are few natives, and fewer still who care to exert themselves beyond taking fish for their own wants, so that the number of fish thus furnished is extremely small, and the canneries can not depend upon this source of supply.

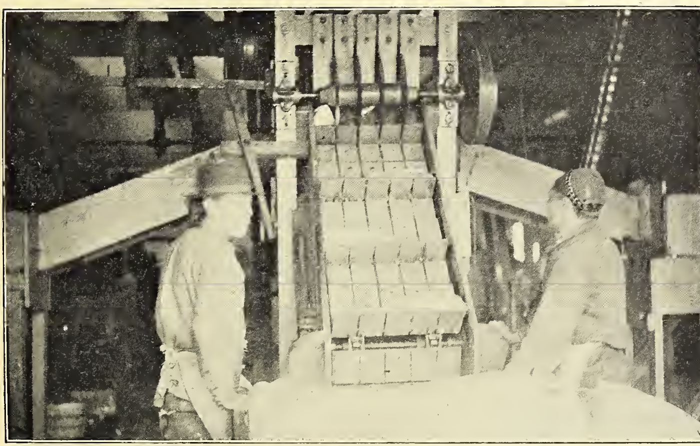
In southeast Alaska, while each cannery has fishermen of its own, a large part of the supply comes by purchase from native and white fishermen. These fisheries are conducted in various ways. A saltery may have been established by a white man near some stream or streams, and a certain right to the fishery is recognized. A cannery makes a contract with him to take all his catch at a certain rate, the steamer calling for the fish at fixed intervals. He employs his own men, boats, gear, etc. Or a cannery may supply natives, who claim to have rights in a stream, with nets and boats on condition that they sell all their catch to the cannery at certain fixed rates. A third method is for a cannery to send its own fishermen into a locality to do the fishing.

Many disputes arise concerning the fisheries. A native, whose ancestors have lived on a certain stream for many generations, and whose rights are respected by

other natives, supplies a certain cannery with his catch, as possibly he has been doing for years. A rival cannery tells the native that he must sell his catch to it, and that otherwise their men will fish the native's stream. The result is overfishing, complaints, bad feeling, blows, and threats of bloodshed. So far as can be learned, there are now no legal rights or title to any fishing-grounds in Alaska except what force or strategy furnish.

LABOR AT THE CANNERIES.

The cannery fishermen are nearly all foreigners, the majority being "north countrymen," or, as they are termed, "hardheads," though there are some fishing gangs comprised of what are called "dagoes," consisting of Italians, Greeks, and the like. When these two classes form different fishing gangs for the same cannery, the north-country crew is referred to as the "white crew."



Cutting machine.

With the exception of Metlakahtla and Klawak, the packing at all canneries is done entirely by Chinese, and it is very satisfactory labor. The canneries make a contract with the Chinese controlling the labor at a stipulated amount per case, guaranteeing a certain pack. If the guaranteed pack is not made, they are paid as though it had been; if the pack is overrun, they are paid for the extras. They are conveyed to and from the cannery in the ships, are given a bunk-house where they all live, are provided with water, fuel, and salt, and are paid collectively, according to contract, from 40 to 46 cents a case, depending upon the location of the cannery and the facilities for packing. The Chinese make all the cans, receive the fish on the dock, where they are tossed into bins from the boats, and do all the labor until the

product is ready for shipment; in other words, they receive the fresh fish at one cannery door and place them at the other in tin cans, boxed, ready for shipment. They have their own bosses, are ready to work at any and all hours, and apply themselves strictly to the work for which they are paid.

At Klawak in the early days Indians were paid $1 per day. Demands for higher wages resulted in a gradual increase until $1.50 per day was reached, while as the Indians became more expert they grew lazier and constantly clamored for increased wages. As the point had been reached where the prices paid for the work done made the pack too expensive to warrant a further increase, the manager decided to pay by piece-work. This was rather difficult to arrange, but was eventually accomplished. It was then found that each one performed about twice the amount that he had ever done by day's work.

Filling machine.

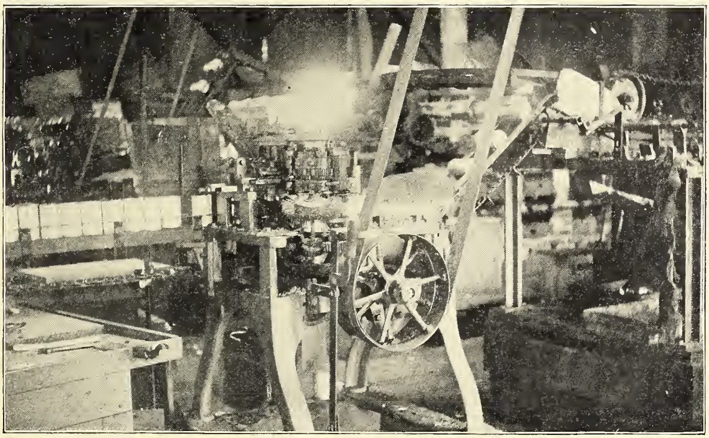
Under the piece-work system the Indian is still dissatisfied. During the time of our visit the labelers struck for higher rates; 25 cents was paid for 12 cases; they demanded 25 cents for 10 cases and got it. It is said that it now costs the cannery 60 cents a case to make the pack; one-half is paid in coin and the other half in store checks; but, deducting the fixed store profits, it still costs the cannery 51 cents a case. Chinese can be employed to make a hand-pack for about 45 cents per case.

At Klawak native women (klootchmen) are employed as labelers, fillers, cappers, and washers; boys as carriers and to assist at the gang-knives; and men in all other capacities. The least amount earned under the schedule is $1.50 per day for women, and from that amount to $2, and one woman has made as high as $4 a day as a labeler;

CANNERY AT LORING.

butchers have made as high as $5.60 a day. The work is not steady, but for the season the native women make from $80 to $100, and the better class of men $200. Fishermen are paid $2 a day, without board, and laborers $1.50 per day, for the time employed.

The complaint is made everywhere that Indian labor—that is, the labor of the men—is uncertain. After making sufficient wages to supply their personal wants and getting a few dollars ahead, the desire for hunting or fishing seizes them and they are apt to leave when they are most wanted. To provide against this contingency, a contract is made with the fishermen, upon which they are paid $1.50 down for every day's work, and the remainder is held until the end of the season; it is then paid if they remain, but forfeited if they leave without permission.



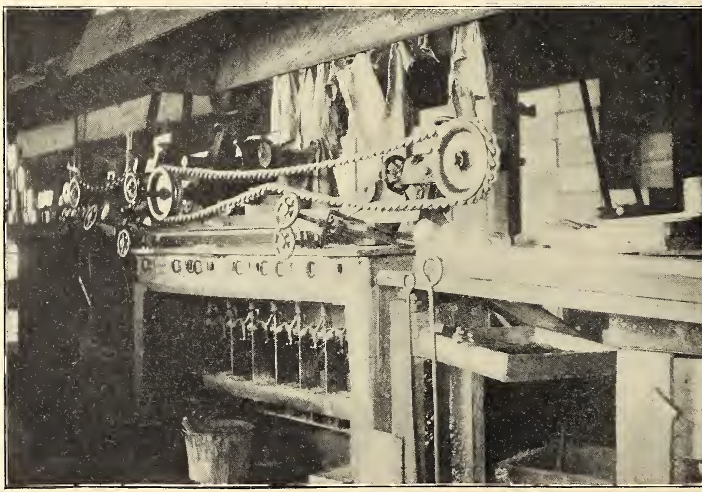
Topping machine.

The Indians are doubtless improvident, knowing that nature has provided for them without much labor. Their frequent boast is that white men and Chinese must work to get something to eat, while the waters and the forests furnish the Indians with all they want. A very small amount of money will supply them with the few necessaries which money alone will purchase.

In the spring of the year, when the cannery is opened, the Indian has spent his money and consumed his supplies. His wants are many, and he is willing to do any work; after these wants are satisfied he relapses, becomes lazy, and demands more wages. The Indians fancy the cannery is getting $6 and $7 a case for salmon, and that they are not getting what is due them. The manager at Klawak said that year after year he had acceded to their demands, but that now they had passed beyond the limit. The Indian is perfectly capable and can probably do the work as well as the Chinese if he could only be made to understand the exact conditions.

THE CANNING PROCESSES.

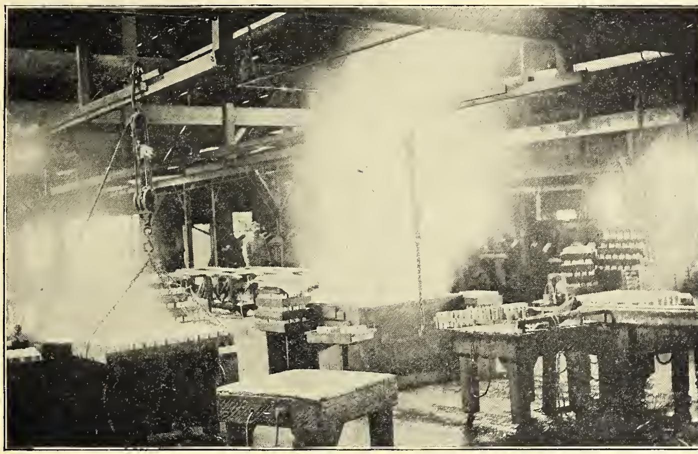
When the salmon collected from the various streams by the cannery steamers are brought to the fish wharf, they are transferred to the fish-bins by men armed with pews (single-tined forks). These men stand knee-deep in fish on the steamer or scow, impale one or two fish at a time, and by a rapid movement toss them to the top of the wharf, where others, also using pews, toss them into bins. The men become very expert in the use of these implements, and a constant stream of fish seems to flow from the steamer or scow to the wharf and thence to the bins. Elevators are used in some canneries, but they are not common in Alaska.



Soldering machine.

It is claimed that fish should be twenty-four hours out of the water before packing, so as to allow them to shrink, as when packed perfectly fresh so much juice is formed that in "blowing," after cooking, light weights are produced. In the fish-house and near the bins are arranged the butchers' tables, where the fish are cleaned. A stream of water is kept playing over the fish in the bins to remove the dirt and slime that collect on them, and they are then transferred to the tables, where the "butcher," after removing the head, seizes the fish by the tail, grasping it at the caudal peduncle, and with a few rapid strokes removes the fins, with one slash opens the fish along the ventral line, and by another removes the viscera. The fish is then transferred to a tank of water, where it is washed and scraped and the tail removed. In a well-regulated cannery it is passed to another tank of water, where it receives a second washing, scraping, and final brushing with a whisk-like broom. Being then thoroughly clean, the fish is transferred to large bins on either side of the cutting machine.

There is great variation in different canneries in all the various processes, but one principle in cutting is kept in view by all; that is, to cut the fish transversely in sections the exact length of the can. The usual method is to have a large wooden, cylindrical carrier, with ledges or rests on the outside the length of the carrier, wide enough to hold the fish, and slit in cross section through the ledges and outer casing to receive the gang-knives. The gang-knives are circular, fixed on an axle at the proper distances apart, and revolve at the highest point reached by the carrier and independently of the latter. The carrier and gang-knives are set in motion, each revolving on its own shaft. As a rest on the carrier comes to a horizontal position, men stationed at the fish-bins lay a fish on each ledge as it passes. Thence it is conveyed to the revolving gang-knives, and, after being divided, passes through and on the downward course the severed fish slides off the rest upon the filling-table.



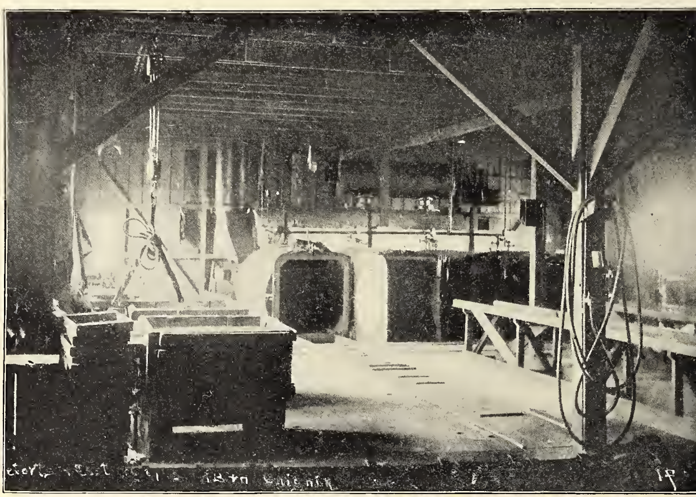
Test kettles.

The cutting carriers of the larger canneries are usually elliptical. This form gives a larger carrying capacity and transfers the divided fish to a higher point, from which the filling is more readily done. In some of the smaller canneries the gang-knives are worked by hand. In this case the knives are not circular, but elongated or semicircular in shape, tapering at the outer ends. They are mounted on an axle having a large iron lever at one end, and when this lever is raised the ends of the gang-knives are thrown up and back. The fish is then placed in position under them and the lever pulled forward, when the knives, with a scimiter-like movement, divide the fish.

Most canneries use filling machines, but as these machines are covered by a patent owned by one of the large packing organizations they are difficult to obtain. One filling machine will fill 800 cases per day, and the larger canneries have from two

to three, and, exceptionally, four filling machines. At some of the smaller canneries filling is done by hand. These are usually establishments that have a capacity of from 400 to 600 cases per day. The machines are only adapted to what is known to the trade as "talls"—that is, the ordinary high 1-pound can. All fancy cans, such as "flats," elliptical, half-pound, etc., are filled by hand.

The filling machine consists of a receiving platform, on which the empty cans are fed, each one reaching a distinct position in its turn. One man at the filling table overhead feeds the divided fish into a hopper, from which it is conveyed to the can underneath, and by a gentle pressure of a piston is pressed into the can, when a movement of the machine conveys the filled can to a table and an empty can into position to be filled. The movement is so rapid that a continuous stream of filled cans



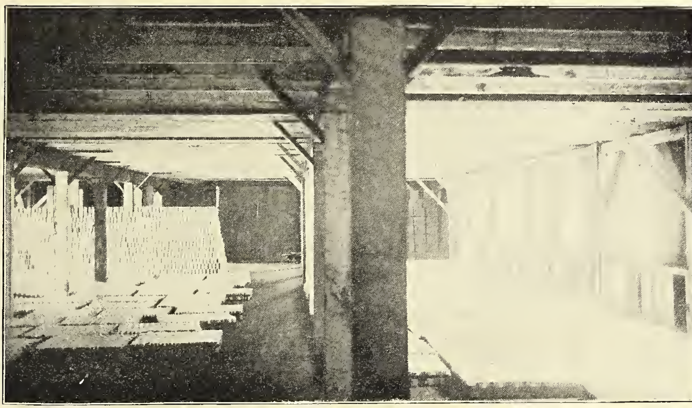
Retorts and test kettles.

is poured on the table. Here the filling is inspected, and, if for export, the cans are carefully weighed, so that there may be no short weight. If they are not quite full a small quantity of fish is added, a supply of small bits being kept at hand for this purpose.

The can is now ready for the top, which in some canneries is put on by hand, but in most cases by a machine. The cans are placed in line and conveyed by a belt to a machine, the tops being fed in through a separate aperture. As the cans emerge with the tops on, a crimping attachment presses the edge firmly around the body, and as it is still carried by a belt, it is turned by the movement of the belt on its side and rolls down a trough to the soldering machine. Here an endless revolving chain passes over the can near the top and rolls its edge into the molten solder. As it emerges from the soldering machine it rolls down a trough and under several jets of water to cool,

and as it comes from the trough it is placed on a table where Chinese seal by hand the central vent, which was left open in the capping process and in the soldering machine, where it becomes quite hot, to let the air escape.

After the central vent is closed the cans are placed vertically in single layers in large open-work trays made of heavy strap iron and holding two cases. The filled trays are now lifted by tackles and iron tongs and lowered into a square wooden tank filled with water heated by steam. This is the first test for leaks. The experienced eye of the Chinese tester at once detects a faulty can by the escape of air, and the can is removed with a pair of tongs and placed aside, where one or more solderers remedy the defects. After removal from the hot-water test the trays are placed one on top of another on cars, and are carried by a railway into the retorts for the first cooking.



Cooling a day's pack.

The cooking is all done by steam in a part of the cannery called the "bath-room." In some canneries the retorts for first cooking are made of heavy plank, well bolted to resist the steam pressure, but in most places they are made of iron or mild steel plate. In the early days the cooking process was a grave secret and none but those interested in the cannery were intrusted with it.

The time of cooking differs somewhat in different canneries, according to the ideas and experience of the superintendent. It is desired to not only cook the fish, but the bones must be cooked so they will crumble between the fingers, as if this is not done the contents may spoil. In some establishments the canned fish is 60 minutes in each retort, in others 50 minutes in the first and from 70 to 80 minutes in the second.

The trays with the hot, steaming cans, bulged out at the ends by the steam within, are then placed on tables where the bath-room men test the cans by the process known as "blowing" or "venting." These men, armed with small wooden mallets, having on the broad face an awl-like point, tap rapidly the top of one can after another,

making a small perforation in each. A fountain-like jet at once appears, caused by the steam escaping, and carrying with it some of the liquor. The vents, after blowing, are immediately soldered and the trays run into the second retort for final cooking. The reason for the two separate cooking operations is that if the cans are kept in the first retort a sufficient length of time to complete the cooking, the steam generated would be so great in the cans that they would be ruined.

At one cannery inspected, where it seemed that more attention was given to exact details of cooking than in some others, there was on the top of the retort a thermometer, connected with the interior, and a separate steam-gauge. The cans to be cooked were placed in the retort, the doors securely clamped, and the steam turned in. The steam gauge was carefully noticed until it showed 6 pounds pressure, where it was maintained, by regulating the stop valve, until the thermometer registered 220° F. The

Lacquer room.

temperature was kept at this point for thirty minutes, when the retorts were opened and the cans removed.

The second cooking at this cannery is as follows: After the cans are placed and the doors secured, steam is admitted until the independent gauge shows a pressure of 12 pounds. It is then maintained at that pressure until the thermometer registers 240°, when the temperature is regulated to 240° for 45 minutes when cooking redfish, or 60 minutes when cooking cohoes. The latter fish are quite large at this cannery, and presumably the longer period is given so that the large bones may be thoroughly cooked. In both cases of cooking, after the desired temperature is reached the pressure falls, while the temperature is held at the proper point.

After the cans are taken from the second retort the grease and dirt on them are removed by a lye bath, the lye is next removed by a fresh-water bath, and the cans

are ready for the cooling room. After cooling they are lacquered by placing them on a tray in an inclined position, which is lowered into the lacquer contained in a rectangular wooden tank, lifted, drained, and removed. When the lacquer is dry the cans are labeled and cased.

After the second cooking they are twice tapped for leaks. Certain Chinese are very expert at this test. With a tenpenny nail they pass rapidly over the cans, striking the top of each, and judge by the sound whether there are any defects.

During the process of canning imperfect cans are found by inspection and testing, and if repaired before the first cooking and immediately processed they are naturally in the same condition as if there had been no defects. If the leaks are discovered after cooking and are repaired at once and the contents recooked, they are still very good, the only difficulty being that by blowing them a second time they lose weight. The above goods usually go in with the regular pack of their kind and are not classed as regular "do-overs."

When a cannery is running to its full capacity defective cans can not be repaired and recooked at once, and are set aside sometimes for days before they are recooked, the result being that decomposition follows, the same as with any other meat that is exposed to the air, and the fish becomes unfit for food. When recooked the fish is mushy, and the blowing makes the cans very light, which is frequently corrected by adding salt water. This, the "do-over," is the lowest grade of goods, and is fit only for chicken food. Such cans are frequently sold to brokers without labels, or else labeled with the name of some fictitious cannery, and find their way into country, lumber, mining, or negro districts, or are sent to the South Seas and semibarbarous localities. Defective cans run from 1½ to 2½ per cent of the output, and those intended to go with the regular pack are usually vented by opening one of the first vents, or the seam at the top, so that additional vent marks may not lead to suspecting the goods.

WEIGHT OF FISH.

Cannery people, in referring to the weight of salmon, always speak of so many to the case. They never weigh the fish, but estimate them by the case, and sometimes make fishing contracts in that manner. This naturally involves another subject: How many live fish are required to make a case of 48 one-pound cans? Much depends upon how the fish are cut. The largest company doing business in Alaska cuts off a considerable portion of the tail and the head well back as waste. Another cannery saves these end pieces and packs them under special labels. A liberal estimate of the loss in cleaning and preparing the fish for the cans is one-third, which would be about 75 pounds of live fish to a case, or 72 pounds if each can contained exactly 1 pound; but as the cream of the pack goes to foreign markets, the cans are always slightly overweight, about an ounce, to prevent a rebate on short weights. My own observation and inquiry among canners who seemed to have given the subject some attention lead me to believe that 65 to 68 pounds of live fish will make a liberal case, depending somewhat on the size of the fish. Fish that run 10 to 12 to the case can be gauged very closely on a 65-pound basis, but for smaller fish this must be increased.

The waste of redfish and cohoes at the canneries is not large, but with humpbacks many are culled out, either on account of being very small or in bad condition. This species, late in the season, when the hump commences to be marked, becomes watery, and it is then difficult to properly fill a can, as much of the weight is in liquor, which

blows off in testing, causing light weight. Under average conditions from 10 to 15 per cent of humpbacks are wasted, and in a season when they are as plentiful as in 1897 as many or more are wasted than are packed. Some years ago, when only a few humpbacks were packed, they were so numerous in Naha Bay that tens of thousands were hauled on the banks and left to decay in order to thin them out.

LABELS AND BRANDS.

Every cannery in Alaska has its own labels and brands, and the same fish are packed in each cannery under various brands. One cannery that was visited had seventeen. The reason for employing so many is briefly as follows: When the canneries were first operated independently each adopted various brands for the same species of fish, and they were introduced into different sections, ultimately creating demand for particular goods.

In spite of these various brands, the highest-grade goods in all, or nearly all, the Alaska pack has some word which conveys to the consumer what is in the tin, if he knows the key. The few cans of king salmon that are packed have the words "king" or "Alaska king" somewhere on the label, but these fish form so small a part of the Alaska pack that they can hardly be considered. The labels for redfish, which forms the great bulk of the pack, as a rule have the word "red" in some connection, such as "red salmon," "choice red salmon," "Alaska red salmon," etc. In some canneries a few of the early cohoes find themselves under a redfish label, but usually a can marked "red salmon" contains that fish.

The cohoes, and frequently the white king salmon, are usually packed under a label that somewhere has the words "spring salmon" on it, and the humpback is covered by the term "pink salmon." The few dog salmon packed are covered either under "pink salmon" or else go in with that heterogeneous mass of tips-and-tails, light-weights, "do-overs," etc. Some of the canneries have not adopted this system of labeling, but with about three-fourths of the Alaska pack the words "king," "red," "spring," and "pink," are used, as just mentioned.

The names of companies which have never had any real existence are sometimes found on labels. Some of these are the Prince of Wales Packing Company, Tolstoi Packing Company, Clarence Straits Packing Company, Moira Packing Company, Coal Bay Packing Company. These are simply names that some years ago were placed on labels of which a few are still in use. They are supposed to represent fish taken at the several localities, but no canneries were ever located at those places or operated under the company titles.

As elsewhere noted, fictitious cannery names are also used to cover "do overs."

MARKETS.

The larger part of the canned redfish goes abroad, principally to England. These are the choicest of the pack, and more than usual care is observed in preparing them, as the European market demands a high grade of goods. The cans are carefully weighed, and contain about 1 ounce more than a pound, so as to be sure to avoid light weights. The cans are carefully inspected for dents or defects, and the fish are the very best. It is usual on European orders to open a certain number of cases and average the order from an inspection of these cans. If they are defective, reclamation is made. The remainder of the pack of redfish, together with the cohoes, humpbacks, dog salmon, tips-and-tails, and do-overs remain in the home market, and some are shipped to Australia, South America, and the South Seas.

PRICES OF CANNED SALMON.

The prices vary with the demand. On account of the large output in 1897 canned salmon that year sold very low. A good average price for the 1896 output was, for king salmon, $1.15; redfish, 90 cents; cohoes, 80 cents, and humpbacks, 65 cents per dozen cans. The prices paid during the winter of 1897–98 were, king, $1.10; redfish, 85 cents; cohoes, 75 cents, and humpbacks, 55 cents per dozen. These are simply averages from first hands in large quantities. One large organization, it is reported, sold 300,000 cases of the best redfish on foreign order, before the pack was made, at 83 cents per dozen. The other grades are sold for what they will bring.

CANS AND BOXES.

It is difficult, without seeing, to appreciate the enormous number of cans used in a cannery. From the time of the arrival of the employees at the cannery, six or eight weeks before the salmon run commences, the Chinese who do the packing are employed in making cans, as their contract calls for the packing work complete, from the making of the cans to the stowing of the labeled, filled cans into the cases.* The body of nearly all cans is made by hand, but there are a few machines in use that solder the long body seams. In nearly, if not quite, all the canneries, after the cans are filled the bottoms and tops are soldered by machinery. To pack 50,000 cases requires 2,400,000 cans, and the Alaska pack in 1897 took about 43,600,000 cans. This requires about 100,000 boxes of tin plate, weighing 10,000,000 pounds (5,000 tons roughly) and costing about $400,000. The tin plate used at present is what is known as 100-pound tin for the body of the can, and 95-pound tin for the tops. It takes about 110 boxes of tin plate for 1,000 cases. Domestic tin is largely used for the pack sold for home use, but imported tin for the export pack. Formerly all tin plate was imported, and what is known in the trade as 110-pound and 112-pound tin was used.

One box of 100-pound tin, 14 inches by 20 inches, English plate, contains 112 sheets of tin plate, weighing 100 pounds, or with the box 5 pounds additional. One box of 95-pound tin of the same dimensions contains 112 sheets of tin plate, weighing 95 pounds net, or with the box 5 pounds additional. The quotations in December, 1897, in San Francisco, on lots of 500 boxes or more, duty paid, were $4.20 per box for 100-pound tin and $4.10 for 95-pound tin. American plate is the same except in price, which at the time the imported-tin quotations were made was for 100-pound tin $3.425, and for 95-pound tin 10 cents less per box, delivered f. o. b. San Francisco in large lots. One-fourth of 1 per cent is said by dealers to cover all deterioration due to rusting, sweating, etc.

For the season's pack it is usual to allow 110 boxes of tin to 1,000 cases of cans. This makes an allowance of $2\frac{1}{2}$ to 3 per cent for rusty plates, losses due to imperfectly cut sheets, and for other cannery uses, as the following will show: One sheet 14 inches by 20 inches will cut 6 bodies or 24 tops of 1-pound tall cans; 1,000 cases, or 48,000 cans, contain 96,000 tops (4,000 sheets) plus 48,000 bodies (8,000 sheets) equal to 12,000 sheets, which is $107\frac{1}{7}$ boxes, or 107 boxes and 16 sheets. Hence 112 sheets, 14 inches by 20 inches, will make 448 tall 1-pound salmon cans, or 1 box of tin plate will make $9\frac{1}{3}$ cases of cans. In canneries generally it is said that actual experience shows that

* In Bering Sea packing commences soon after the ice permits the vessels to enter the estuaries. As a rule, empty cans are carried from San Francisco to these canneries.

1 box of tin will make only $9\frac{1}{6}$ cases, at which rate it will take $109\frac{1}{10}$ boxes of tin to 1,000 cases.

There is a rebate of 99 per cent of the duty on imported tin used on the export pack, but under the present ruling every box must be accounted for, and it is said that under these conditions only about 75 per cent is realized on account of the inability to account for the disposition of every box.

The boxes in which the canned salmon is packed in Alaska are mostly made in Puget Sound and carried up in shooks. The cannery at Metlakahtla turns out its own boxes, and the sawmill in Tongass Narrows, operated by Metlakahtla Indians, supplies Loring and Wrangell. As lumber can not legally be exported from Alaska, there is only a small local demand for the product of the sawmills.

DEPLETION OF STREAMS.

When a person interested in a cannery is questioned regarding the decrease of salmon in Alaskan waters, he is likely to assure you at once that there are just as many salmon in the streams as there ever were, and begins his proofs by citing years like 1896, when there was a large run of redfish in Alaska; but any disinterested authority on the subject will say that the streams of Alaska are becoming depleted. While it can hardly be said that the streams will fail entirely within a few years, there is no doubt that the average runs show fewer fish year by year, and if the laws are not amended and *enforced*, the time will come in the not very distant future when the canneries must suffer through their own actions.

It is a difficult matter to furnish convincing proofs to those who do not wish to be convinced, and any argument may fail with those who are interested commercially. It is also difficult to establish proof by statistics, because accurate stream statistics, as a rule, can not be obtained; and, as to packs, the canneries have multiplied in numbers, and many of them have been so enlarged that no comparison can be made. The causes of the depletion are the barricading of streams and overfishing; in other words, *illegal* fishing.

In the examinations of the various streams, as outlined in the following pages, all resources have been exhausted to obtain data showing their past and present condition. It must be evident to anyone referring to the records of the streams that they are furnishing fewer fish than formerly, in spite of the improved gear and appliances. The results of barricading are illustrated in such streams as Karta Bay, Naha Bay, Yes Bay, Klawak, Redoubt, and many others in southeast Alaska; in the streams of Prince William Sound district, on Afognak Island, and at Chignik. The illegal obstruction of streams by barricades is more apparent in southeast Alaska than elsewhere because the streams are small, there are many of them, and they are easily closed; but from all reports made to me, even by cannerymen, the district of Prince William Sound is and has been more heavily barricaded in proportion than southeast Alaska.

The following may be some evidence bearing upon the subject of depletion: Taking, for instance, a section of southeast Alaska, from Behm Canal and Prince of Wales Island south and east, in 1889 four canneries were operated, viz, Loring, Burroughs Bay, Ketchikan (burnt that year, but packed 13,000 cases), and Yes Bay. In 1897 four canneries also operated, viz, Loring, Yes Bay, Metlakahtla, and Quadra. In 1889 the packs were made from the streams near the canneries—that is, from the "home streams"—and nearly all were redfish, with a few cohoes and probably very few hump-

WEST BRANCH OF SKOWL ARM.

BARRICADE IN WEST BRANCH OF SKOWL ARM.

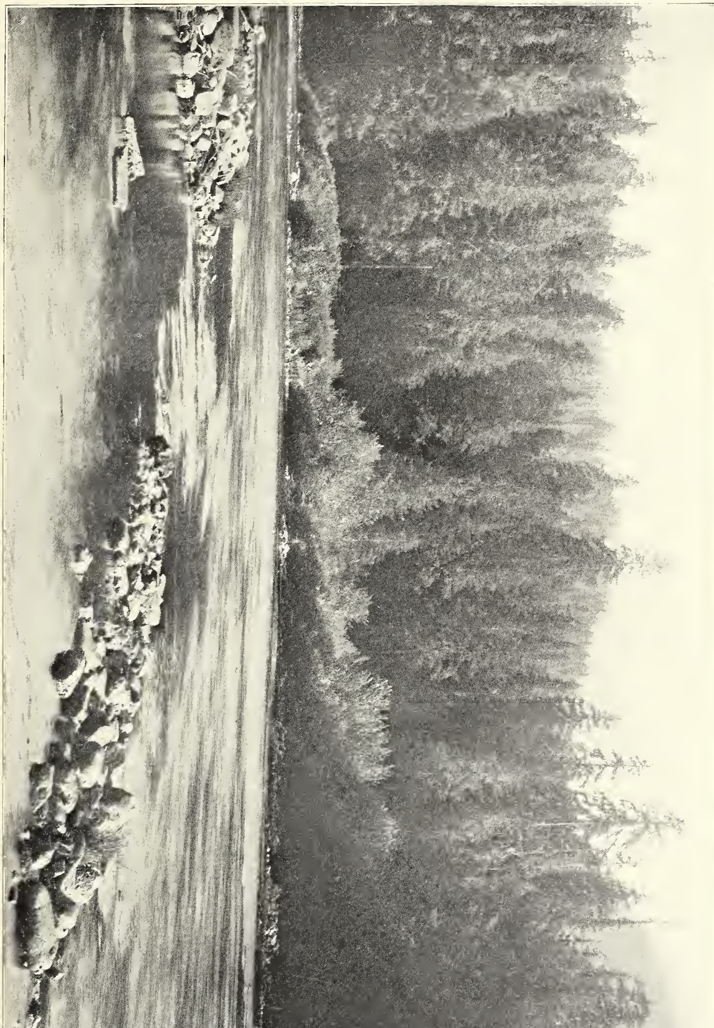
BARRIER IN SALMON STREAM AT HEAD OF NICHOLS BAY.

BARRICADE IN SALMON STREAM, NEAR HESSA.

SECOND BARRIER IN STREAM AT HELM BAY.

DAM IN OUTLET TO LAKE, REDFISH BAY.

BARRIER IN STREAM AT HELM BAY.

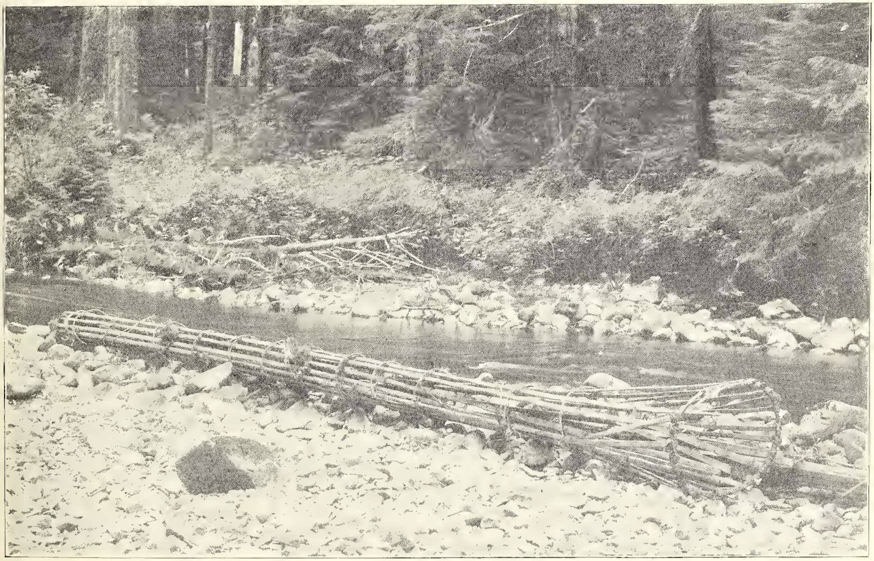


OLD FISH-LEAD IN STREAM AT KARTA BAY.

BARRIER IN STREAM AT M'DONALD BAY.

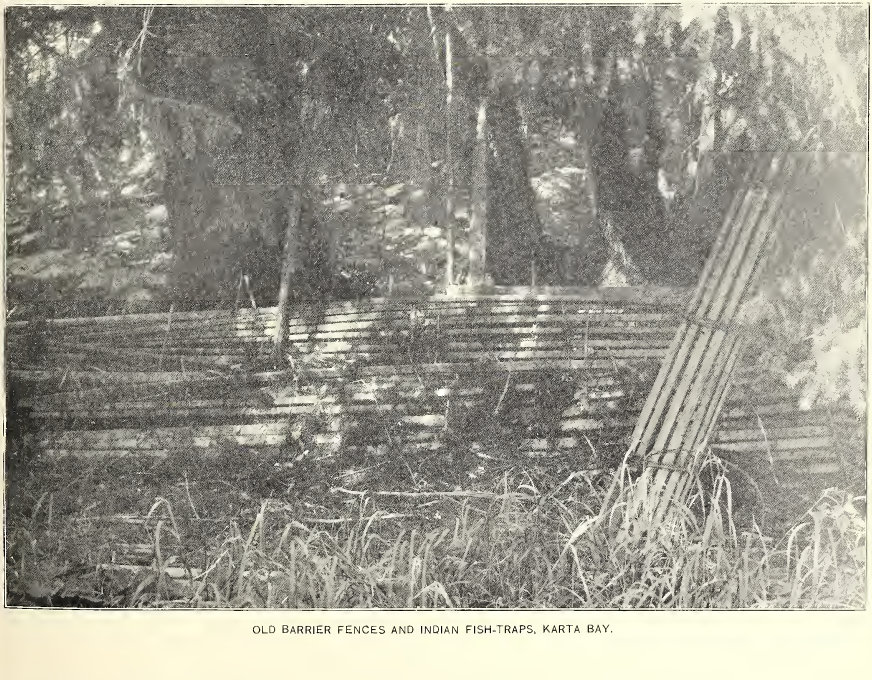
FISH-TRAP IN M'DONALD BAY.

BARRIER IN STREAM ENTERING FIRST INLET, SOUTH SIDE OF MOIRA SOUND.



INDIAN FISH-TRAP AND ARTIFICIAL CHANNEL IN STREAM, FIRST INLET, SOUTH SIDE OF MOIRA SOUND.

BARRIER ACROSS STREAM AT NORTH ARM, MOIRA SOUND.



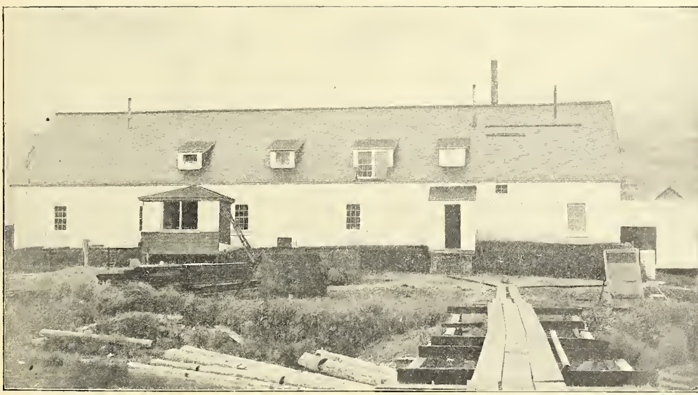
OLD BARRIER FENCES AND INDIAN FISH-TRAPS, KARTA BAY.

OBSTRUCTION AT KLAKAS, FROM ABOVE.

OBSTRUCTION AT KLAKAS, FROM BELOW.

backs, for the latter were not in favor and few were packed. In 1897 the pack for the same section is double the 1889 pack, but they are nearly all humpbacks. The pack of redfish is certainly very much less, yet *all* the streams within 70 or 80 miles of the canneries have been scoured with all the gear that could be devised or used.

Probably nowhere is the depletion more noticed than in Copper River Delta and Prince William Sound district. In 1890 the two canneries used 20 boats, each with 150 fathoms of web, besides seines, and fished Mountain Slough, Eyak Lake and River, and Algonek and Glacier sloughs in the delta, and Miner River and Cheniga in Prince William Sound. In 1897, to make a slightly increased pack, one cannery used 32 boats, the other 43, all with 450 fathoms of web to a boat, and they fished all the streams from Chilkhat River to Eyak in the delta, and all the streams in Prince William Sound. There is no doubt in the minds of the people of Prince William Sound that the streams are being depleted.



Redfish hatchery at Karluk.

At Karluk, in spite of the great run of 1896, it is conceded that the average run is smaller than in the early days of fishing off this river.

At Chignik, from 1890 to 1896, an average of 61,400 cases per year were packed from that stream by one organization. In 1896 three separate canneries, with all their forces and every effort they could make, only packed about 65,000 cases of Chignik fish; and in 1897, by doubling their efforts, they reached a pack of 74,159 cases. Any-one who sees the fisheries at Chignik will readily understand that the stream can not stand the excessive fishing.

It was a matter of great surprise to discover, as the investigations progressed, the large number of streams which were either actually barricaded, or which showed indications of having been barricaded, notwithstanding the strict law forbidding such obstructions, the maximum penalty being $1,000 fine, three months' imprisonment, and a fine of $250 per day for every day the obstruction remains.

When the attention of those known to have an interest in keeping the salmon streams in a normal condition has been called to the existence of barricades, with the expectation of having them join in protests against their construction, it has been surprising to hear some defend barricading as right, and the belief has been inevitable that if such persons were not directly concerned, they at least encouraged these practices. The statement was made in certain localities that it is impossible to obtain sufficient fish to compete with other canneries without barricading. This is very true, but the argument is absurd, and needs no comment. Equally absurd defense of barricades was made in other parts of Alaska.

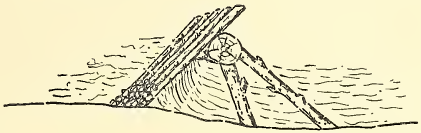
The effect of barricades can be readily appreciated. Salmon come to the streams to ascend for spawning at certain dates, from which there is little variation. At first a few stragglers appear, then small schools, and the schools grow larger and larger as the season advances. At the mouths of the streams the fish accustom themselves to the new conditions in brackish water, and if the river is open to their passage they soon ascend to the lakes and thence to the spawning-beds. A whole school has been known to ascend in one night. If the stream is barricaded, preventing their ascent, they school around in the bay or inlet at the approaches of the streams, may apparently leave the vicinity for a short time, and then return and repeat this process many times. While thus schooling in the salt water they do not reach a spawning condition so rapidly, and continue suitable for canning a longer time. Some of the fish that are more advanced toward the ripening period, in their frenzy to get to the spawning-grounds, fairly attack the obstruction and have been known to dash themselves against the timbers with such force as to be killed or die of exhaustion caused by the repeated attacks. Briefly, the barricades corral the fish, and thus permit the fishermen to catch all at little expense; they are also said to keep them from ripening rapidly, and thus permit the cannerymen to pack good-quality fish much later in the season. This seems to be shown in the 1896 catch at Hetta, where—not from the action of barricades, but because the fish, on account of the extreme low water, could not ascend until the late September rains raised the water—over 40,000 redfish were taken between September 1 to 20. It is claimed that after the fishing season is over some of the rails of the barricade are knocked out to allow the remaining stragglers to pass through, but this is doubtful.

The defenders of barricades state that when the water in the rivers is high it flows over the ends of the rails, and some redfish leap the barrier, while the other species and the trout are kept out, and thus the eggs of the redfish are preserved. But the barricades are generally so constructed that if a few fish find a passage the same proportion of one species passes in as another.

The origin of barricading Alaska salmon streams dates back to a period prior to the acquisition of Alaska by the United States. The Russians built "zapors" or dams with stone piers across the streams, near the settlements, from which they drew their salmon supply. The ruins of some are still standing, at Redoubt, Afognak, and other places. The injury these zapors caused to the fisheries is acknowledged by everyone who has any knowledge of the subject. The Russians doubtless received the idea of barricading the streams from the Indians. When the first fisheries for the canneries were organized, "these little Indian devices," as they were called by a person interested in Indian education, were in use, and in some instances were so ingeniously arranged that the fish were carried out high and dry into a basket. At one place (Klawak)

an Indian owner of a stream used to boast that his trap was so cleverly arranged that not a fish could get up the stream; that he caught them all. It is said that the Indians appreciated the necessity of allowing the fish to ascend the streams to spawn, and therefore after obtaining their winter supply they opened the barricades. That barricading has been done in recent years by the Indians there is no doubt, for in a number of instances evidences of recent barricading were found on streams presumably fished by Indians only. If the law were translated into Chinook, printed on muslin, and posted in every Indian village and explained to the natives, it would have an excellent effect.

The general form of these barricades is the same, and a description of one in Nichols Bay stream, Prince of Wales Island, may answer in a general way for all. The barricades extend solidly across the stream, and the best idea that can be gained of this construction is by reference to the illustrations accompanying this report. They are located near the high-water mark and, if possible, at a point where a pool is formed immediately below the obstruction. A tree, 2 or 3 feet in diameter, is felled across the stream, and then cut to a proper length so as to make a log that reaches from bank to bank and from 4 to 6 feet above the surface of the stream. This log is then jammed and wedged into the rocky ledges on each side of the banks, supported underneath to pverent it from sagging, and braced from the downstream side by heavy beams to resist the great pressure brought by the floods. Straight saplings, 18 to 20 feet in length and 3 to 4 inches in diameter, are cut, sometimes split lengthwise, and laid in the direction of the stream over the log, the butts embedded in the river bed upstream and covered with the river deposit, and the lower ends projecting over the log several feet. These split rails are laid solidly side by side from bank to bank. The water at ordinary stages flows through the interstices, and in heavy floods over the ends.



End view of barricade, showing method of construction.

The barricades are usually so solidly built that they resist the ordinary drift, and at most have but a few rails, which are easily replaced if knocked out. Frequently a second tree is partly cut, so as to have it ready in case of accident to the barricade. Such was the construction of the one at Nichols Bay stream, and in addition, at one side where there was a branch, a wire netting was stretched across.

It is readily seen that the fish in passing upstream go under the log and are prevented from further ascent by the rails, and as their spawning instinct keeps them heading the current, they remain in the vicinity and are easily captured. This barricade was so solid that not a fish could pass through; it is probable, however, with a full stream and the water pouring over the end, that a few salmon following the stream may leap the end rails. To prevent this there is sometimes an effective addition in the shape of a galvanized iron wire netting stretched across the top in the direction of the log, from bank to bank, to catch the strays that might succeed in leaping the barrier. In some instances, instead of the split rails, there are heavy rails laid upstream, about 4 feet apart, and over these are secured light frames of openwork like the lathing of a lobster pot, but heavier, through which the water can flow while excluding the passage of fish.

THE ALASKA SALMON LAW.

The following act, passed June 9, 1896, relating to the salmon fisheries of Alaska, is the one now in force:

AN ACT to amend an act entitled "An act to provide for the protection of the salmon fisheries of Alaska."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act approved March second, eighteen hundred and eighty-nine, and entitled "An act to provide for the protection of the salmon fisheries of Alaska," is hereby amended and reenacted as follows:

That the erection of dams, barricades, fish wheels, fences, or any such fixed or stationary obstructions in any part of the rivers or streams of Alaska, or to fish for or catch salmon or salmon trout in any manner or by any means, with the purpose or result of preventing or impeding the ascent of salmon to their spawning ground, is declared to be unlawful, and the Secretary of the Treasury is hereby authorized and directed to remove such obstructions and to establish and enforce such regulations and surveillance as may be necessary to insure that this prohibition and all other provisions of law relating to the salmon fisheries of Alaska are strictly complied with.

SEC. 2. That it shall be unlawful to fish, catch, or kill any salmon of any variety, except with rod or spear, above the tide waters of any of the creeks or rivers of less than five hundred feet width in the Territory of Alaska, except only for purposes of propagation, or to lay or set any drift net, set net, trap, pound net, or seine for any purpose across the tide waters of any river or stream for a distance of more than one-third of the width of such river, stream, or channel, or lay or set any seine or net within one hundred yards of any other net or seine which is being laid or set in said stream or channel, or to take, kill, or fish for salmon in any manner or by any means in any of the waters of the Territory of Alaska, either in the streams or tide waters, except Cook Inlet, Prince William Sound, Bering Sea, and the waters tributary thereto, from midnight on Friday of each week until six o'clock antemeridian of the Sunday following; or to fish for or catch or kill in any manner or by any appliances, except by rod or spear, any salmon in any stream of less than one hundred yards in width in the said Territory of Alaska between the hours of six o'clock in the evening and six o'clock in the morning of the following day of each and every day of the week.

SEC. 3. That the Secretary of the Treasury may, at his discretion, set aside any streams as spawning grounds, in which no fishing will be permitted; and when, in his judgment, the results of fishing operations on any stream indicate that the number of salmon taken is larger than the capacity of the stream to produce, he is authorized to establish weekly close seasons, to limit the duration of the fishing season, or to prohibit fishing entirely for one year or more, so as to permit salmon to increase: *Provided, however,* That such power shall be exercised only after all persons interested shall have been given a hearing, of which hearing due notice must be given by publication: *And provided further,* That it shall have been ascertained that the persons engaged in catching salmon do not maintain fish hatcheries of sufficient magnitude to keep such streams fully stocked.

SEC. 4. That to enforce the provisions of law herein, and such regulations as the Secretary of the Treasury may establish in pursuance thereof, he is authorized and directed to appoint one inspector of fisheries, at a salary of one thousand eight hundred dollars per annum; and two assistant inspectors, at a salary of one thousand six hundred dollars each per annum, and he will annually submit to Congress estimates to cover the salaries and actual traveling expenses of the officers hereby authorized and for such other expenditures as may be necessary to carry out the provisions of the law herein.

SEC. 5. That any person violating the provisions of this act or the regulations established in pursuance thereof shall, upon conviction thereof, be punished by a fine not exceeding one thousand dollars or imprisonment at hard labor for a term of ninety days, or both such fine and imprisonment, at the discretion of the court; and, further, in case of the violation of any of the provisions of section one of this act and conviction thereof a further fine of two hundred and fifty dollars per diem will be imposed for each day that the obstruction or obstructions therein are maintained.

This law, like others that have preceded it, is generally regarded as inadequate in some vital respects by those having the interest of the salmon fisheries at heart; but there is little agreement among cannery people as to what the law should be. There is, however, a general inclination toward a tax on the output of each cannery

and saltery for the support of hatcheries, and the suggestion that streams be leased for a term of years has everywhere met with favor.*

It must be admitted that the laws and regulations pertaining to Alaska salmon fisheries are very generally disregarded, and that they do not prevent the illegal capture of fish. There is one case in which the law is likely to be respected, and that is when rival canneries, fishing in the same locality, are not mutually benefited by its non-observance.

In conversation with the superintendent of one cannery it was remarked that, so far as experience and observation went, it was exceptional to find a cannery that did not pack some fish taken illegally. He seemed very much surprised, and desired to impress upon me that in that district the law was observed. Ten minutes afterwards he acknowledged that they did not observe the weekly close season, and the following day it was learned that one stream fished by this cannery was filled with nets from mouth to source, and that in the lake at the head of another stream there was a trap planned by the foreman of the cannery.

It is probably true that fish are sometimes carried to canneries that have been taken illegally without the knowledge of the superintendent, for the reason that, excepting the home stream, he does not see much of the fisheries, as his time is taken up with the canning operations. In general the cannerymen would like to see the law enforced if it could be done impartially. While in a minor degree the law may be defective, and, owing to the varying conditions found in the vast extent of territory involved, may need amending, still it is good as it stands, and for the present it only needs enforcement, and this is not a difficult matter if the proper steps are taken. Without considering the large amount of money invested in the salmon fisheries of Alaska, the output is worth in round numbers $3,000,000 a year. Should not such an industry be fostered and properly protected?

Reference is made to the reports of the salmon inspectors published by the Treasury Department to show the nature of the work performed by these officials and the obstacles they encounter in the performance of their duties.

My own criticism of the law is briefly as follows: It was evidently framed upon the basis that the salmon fisheries of Alaska were confined to large rivers like the Columbia and Fraser, while the fact is that 70 per cent of the Alaska pack is taken from around the mouths of comparatively small streams, and each stream presents certain

* In April, 1898, the Secretary of the Treasury sent a letter to the House of Representatives in which amendments to existing laws were proposed as follows and for the reasons stated:

The present salmon-fisheries laws have been found inadequate to meet existing requirements, and their amendment along the line of the inclosed bill is recommended in the light of subsequent investigation by Government agents after careful consideration of the questions which the present law fails to meet. The material changes in the present law embodied in the inclosed draft are, briefly:

First. The erection of traps only under regulations prescribed by the Secretary of the Treasury.

Second. The withdrawal of the protection afforded by the present law to salmon trout, it being generally understood that the latter species are destructive to salmon spawn and fry.

Third. The extension of the operations of the law to the territorial waters of Alaska, thereby preventing the erection of stationary obstructions in the approaches to rivers and streams.

Fourth. The prohibition of the erection of salmon canneries in Alaska without a permit from the Secretary of the Treasury.

Fifth. The requirement of a detailed annual statement of the operations of all canneries and manufactories of fish-oil production to the special agents for the salmon fisheries.

Sixth. The detailing of an employee of the Treasury Department to act as an additional special agent without extra compensation.

Seventh. The imposition of a tax upon the output of all canneries, salteries, fish-oil or fish-fertilizer works.

Eighth. Changing the penalty for violation of this act from a maximum fine of $1,000 to $5,000.

peculiarities, so that it is difficult to protect the fisheries by a general law, and it must be left to departmental regulations.*

The first section of the present law, wherein it is stated "or to fish for or catch salmon or salmon trout in any manner or by any means, with the purpose or result of preventing or impeding the ascent of salmon to their spawning-ground, is declared to be unlawful," places the whole matter in the hands of the Secretary of the Treasury. The second section, relating to the weekly close season, should in my opinion make no exception *in any district*. The plea is probably made that in the districts exempted the fish are taken in gill nets, which permit some fish to pass all the time; but if this is the plea it is a mistake. Every cannery in Bering Sea and Cook Inlet uses traps besides gill nets, and is there any reason why traps should be used at those places during the weekly close season and not at Chignik? In Prince William Sound neither traps nor gill nets are used; all fish are taken in seines—yet it is exempt from operation of the close-time provision of the law. The fisheries in this locality are on the same footing as those in southeast Alaska, except that gill nets are used in Chilkat and Taku inlets and at the mouth of the Stikine. If the exception is made on the gill-net plea, then the law should provide that "all canneries obtaining their fish by gill nets *exclusively* are exempt." If the exception is made on account of a short fishing season, it might hold good for Bering Sea, but in no other place, though I should be opposed to any exemption. The run of redfish in Cook Inlet and Prince William Sound is for a long period, and in fact for a longer period than in the southeast Alaska district, and on these pleas there is absolutely no reason for exempting those places.

The time of the weekly close season should by all means be changed so as to include Sunday. As it stands, it was no doubt intended that the canneries should pack the Friday's catch on Saturday and be closed on Sunday. If the law were observed it would permit the Chinese, who know no Sabbath, to rest on that day, while the white fishermen and Indians would be obliged to work on that day. We send missionaries among the Indians and teach them to keep the Sabbath, and then enact laws which compel them to work. Mr. Duncan, at Metlakahtla, states that his Indians do not fish during the close season on account of the law, and would not on the Sabbath on account of his teachings, and the law therefore bears hard upon that community.

The first part of section 2 might as well read so as to make it unlawful to take salmon in any river or stream above tidewater, with the exceptions given in the act, for the reason that there are no fisheries in Alaska, so far as I know, above tidewater in any river or stream over 500 feet in width. This section would, however, be very much improved if "tidewater" were stricken out and the section made to read "in any of the rivers, streams, or estuaries less than 500 feet wide," and then the last provision

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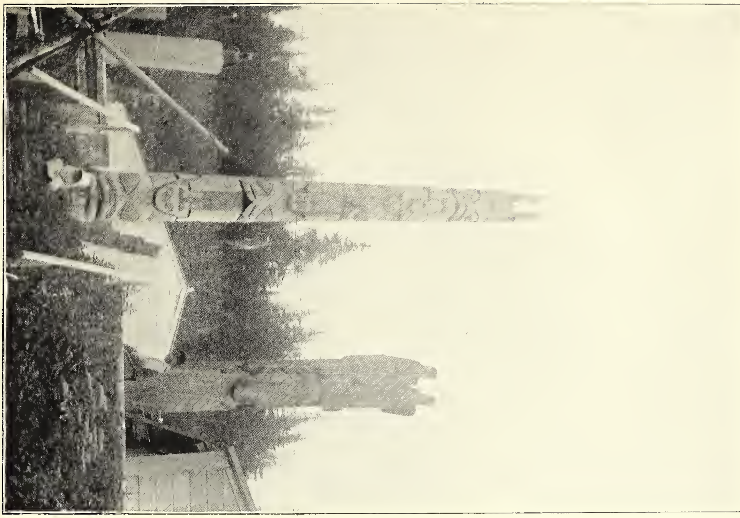
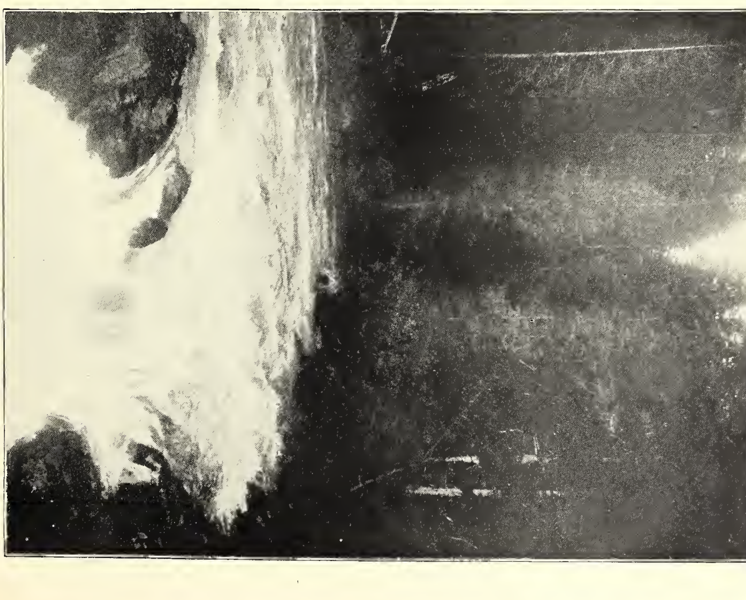
*The bill making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1897, contained the following provision:

"For the protection of the salmon fisheries of Alaska, under the direction of the Secretary of the Treasury, seven thousand dollars, to be immediately available: *Provided*, That in lieu of the three inspectors whose employment is authorized by the act of June ninth, eighteen hundred and ninety-six, there shall be appointed by the President, by and with the advice and consent of the Senate, one agent at a salary of two thousand five hundred dollars per annum, and one assistant agent at a salary of two thousand dollars per annum." (Statutes 55th Cong., 1st sess., chap. 2, 1897, p. 29.)

The sundry civil bill for the fiscal year ending June 30, 1898, appropriated the same amount for the protection of the salmon fisheries, without specifying the salaries to be paid.



TOTEMS AT KASAAN VILLAGE.



CASCADE IN STREAM, KETCHIKAN.

of the section could be cut out entirely. The words "rivers, streams, and channels" should be used with considerable caution as to the meaning. There should also be a proviso making it unlawful to pack fish taken illegally.

The Treasury Department is empowered to establish regulations governing the salmon fisheries, and the first section gives ample power in the matter. There are several technical points which need explanation and should be embodied in the regulations. The most important of these refers to section 2, and is as follows: Does the law, so far as it relates to rivers or streams that receive tidal waters, refer to the conditions at low water or at high water? As a rule there are great flats off the mouths of the Alaska rivers, and, as there is a rise and fall of tide of from 15 to 40 feet, varying in the different sections, the topographical features appear very different at low water from what they do at high water. Low water is the proper base to which the laws should apply, and is the plane to which Government surveys are reduced on all charts. Everything pertaining to hydrography is reduced to low water, and on published surveys the dividing line between land and water is the line cut by the low-water plane. This is a question of vital importance and a decision should be rendered.

The same question involves the legality of traps in the Kussilof River and others to the westward. The point is whether or not they are in the river. The Kussilof River at high water has its mouth at the point where it debouches into Cook Inlet, where the banks are both defined within the meaning of shore people; while at low water the stream flows between steep and well-defined banks that are covered at high water, yet they are banks, and the mouth is then a long distance from the high-water mouth.

One of the traps at Kussilof is between what might be called the high-water mouth and the low-water mouth of the river. It is the one near the cannery on the southern bank. The leader commences at high-water mark and extends down the left bank with the heart in the low-water river, which is quite narrow. At high water the trap is clearly outside of the river, at low water it is as clearly inside, but it is then mostly uncovered and on dry land, and serves no more purpose in catching fish than a line of telegraph poles. This low-water river is very shallow; in fact, it has a bar at the mouth which dries at the lowest tides, so that fish do not ascend at low water, but probably only at high water, when they trim closely around the shore and are deflected into the trap. It is said that the traps at Kenai are similarly located, and are in fact in the river. We did not visit Kenai, as no cannery has been in operation there for a number of years, and as the fishing season was all over and the traps pulled up at the time of our call.

A decision on the following point is also very necessary: There are several bodies of water in Alaska which are joined to the sea by narrow passages which at low tide are rapids, thus making lakes or lagoons of these interior bodies, and during the last of the flood tide the water flows in, forming them into tidal basins. Naha and Karluk are examples of this, but others may be found. If the plane of low water is decided upon as the meaning of the law, some of these bodies probably become lakes; but is it illegal to take a salmon in a lake? The law prohibits fishing by any means that prevents the parent salmon from reaching the spawning-ground; but, so far as I can learn, nothing is said about fishing on the spawning-ground in the lakes, which is vastly more important than fishing in the streams. My opinion is that, in *ascending* a river from the sea, when that "river, stream, or estuary" once attains a width in

which it is illegal to fish, even though it afterwards widens into a lake or basin, it should be regarded, so far as the law is concerned, as of the width restricted by the law, for the lake or basin can flow no more water than the narrow part of the outlet unless there are more outlets, which is exceedingly improbable.

Traps should either not be allowed or else should be regulated. The leads, heart, and wings should not be permitted to extend over more than one-third of the width of the channel (not width between banks), and the shore end of the leader should not be permitted to approach nearer the shore than 100 feet from the low-water mark, and no trap should be permitted within 300 yards of any other trap.

Under section 1, of the law quoted, the Treasury Department should by all means regulate the fishing in approaches to the stream. It is recommended that off the mouths of all streams in which fishing is prohibited by the act, no fishing be permitted, except by rod or spear, over an area formed by drawing a line from a point 100 yards on either side of the river, in a direction parallel to the flow at the mouth and extending 500 yards into the bay, arm, or sea. In several localities the seines are run across the mouths of the rivers, and one seine follows another in such rapid succession that but few fish can ascend, for it must be remembered that a seine dragged through the water must necessarily frighten the fish, and those that are not taken probably do not return for an appreciable time, and then only to encounter another seine.

The law does not provide for a sufficient number of inspectors. Six would not be too many, and it should be stated that the appointees shall be practical fishermen, who must be in the field from the time fishing begins—in some districts early in May—until it closes, in some districts about the 1st of October.

The inspectors should be clothed with the power to reject fish that are unfit. Fish out of the water for more than forty-eight hours should be rejected. It may be considered by some that this is too short a time; that the weather of Alaska will permit fish to remain in good condition for a longer period. But this is not the case; during the packing season there are at times warm days, and there is much rain and fog, the fish are handled in masses, and deterioration is rapid.

The superintendents of the canneries of the largest organization that operates in Alaska are instructed not to pack fish that have been more than forty-eight hours out of the water. There are probably fewer bad fish packed than is usually believed by the public, yet many are packed that are unfit.

Reference has already been made to the manner in which fish are collected at some canneries from distant points. These fish are often two days old when collected, and before they are finally packed three or four days have elapsed, and they are then probably unfit for food.

In order that the productive capacity of the streams may be known, the law should provide that each cannery, saltery, or person engaged in packing, canning, salting, or drying, or otherwise preparing salmon for commercial purposes, must, on or before December 31 of each year, submit to the Treasury Department a sworn statement giving the number of cases, boxes, barrels, bales, or bundles of *each* species so prepared, and the number of fish of each and every species used in the business, separately for each stream, together with the dates when fishing was commenced and ended in each stream. Without this information it is simply impossible to ascertain the correct value of the streams and to regulate the fisheries.

The law should also provide that all cans should be distinctly marked with the name and location of the cannery and the kind of salmon packed.

INDIAN GRAVE AND TOTEMS, KLINKWAN.

RELATIONS BETWEEN THE SALMON FISHERIES AND THE INDIANS.

Whenever the *Albatross* anchored near any locality either permanently or temporarily inhabited by natives, a delegation of the older men or chiefs came on board and requested an audience. The powwows which followed invariably took the form of relating the oppression of the white man. At Klinkwan, Chacon, Klakas, Klawak, Metlakahtla, Kasaan, Karta Bay, and, in fact, everywhere, the Indians were greatly exercised over their condition, and notwithstanding that they were repeatedly informed that the Fish Commission party had nothing to do with the execution of the law and was merely in the country for the purpose of examining the fisheries, they insisted that, as we were Government officers, we must hear them.

The permanent Indian villages during the spring and summer months are practically deserted except by a few old people, the young men and women being away, living in camps and curing their winter supply during the spring, and when the canneries open, fishing for them or doing work about them. The canneries at Klawak and Metlakahtla are operated by Indians, the former drawing quite a number from Howkan and Klinkwan. At Chacon the Indians from Kasaan were curing halibut, and they were again met at Hunter Bay, where they had come for cannery work. It is only during the winter that the permanent villages are fully inhabited.

They are essentially fish-eating Indians, depending upon the streams of the country for a large amount of food supply. These streams, under their own administration, for centuries have belonged to certain families or clans settled in the vicinity, and their rights in these streams have never been infringed upon until the advent of the whites. No Indians would fish in a stream not their own except by invitation, and they can not understand how those of a higher civilization should be—as they regard it—less honorable than their own savage kind. They claim the white man is crowding them from their homes, robbing them of their ancestral rights, taking away their fish by shiploads; that their streams must soon become exhausted; that the Indian will have no supply to maintain himself and family, and that starvation must follow.

The natives urge that the law prohibiting them from owning mining claims is very hard to endure; that they wear the same clothes, eat the same food, obey the same laws as the white man, and are far more orderly than the white communities, and that they should have the same rights. They acknowledge the white man's superiority; all they want is suitable encouragement to imitate him. The Prince of Wales Indians also complained against the Metlakahtla community, stating that the latter are foreigners and come to their island, cut out the best timber, and carry it to their sawmill at Metlakahtla. While acknowledging the Metlakahtlans as superior in intelligence, they say that they would gladly embrace the same opportunities.

From the Indians' standpoint, their complaints are undoubtedly well founded, but history will no doubt repeat itself here, as in other portions of our country, where the aborigines have come in contact with the civilizing influence of the white man, where rum, disease, and mercenary dealings have slowly but surely exterminated them. My own sympathy is with the Indian, and I would gladly recommend, if the way were clear, the establishment of ownership in streams; but it is impracticable, and I can only ask for him a consideration of his claim and, whatever law is framed, that a liberal balance be thrown in his favor.

In operating the canneries, the Indian sees the value of the fish; he sees a means for obtaining money, the purchasing power of which he knows as well as does the white man, and if he could possess all the fish which he believes are his by right of inheritance, he would have plenty of money. In some instances canneries recognize well-established Indian rights to salmon streams by paying the chiefs a certain amount per year for the privilege of fishing, but in many cases unscrupulous white men have gone among them with promises, only to break them when payment was due.

It can not be denied, however, that the Indian is better situated now than he was before the canneries were established, or than he would be if the canneries were moved out of the country or abandoned. So far as his fish supply is concerned, it has not been seriously curtailed for his own use and can not be in the future, for long before salmon become extinct the canneries will be abandoned as unprofitable. It probably takes a little more work to get his winter supply now, but the money which the canneries bring him permits a purchase of various foods, and so a large supply of fish

Catch of halibut on deck of steamer *Albatross*, near Killisnoo.

is not as necessary as formerly. The canneries bring the Indian ready money, far more than he can earn by labor in any other way, and if he is at all industrious he can earn sufficient during a canning season to support himself and his family during the winter. The canneries will most willingly pay for all the fish he brings them, or they will give him work at the cannery if he can be depended upon. Here, of course, is the chief difficulty. The cannery season is short, and men must be employed who are willing to give their labor at all times, and the Indian tires of his work very quickly. In the midst of it he is often seized with a desire to leave; he must hunt, or he must get fish for his family, although his wages for a day will purchase more fish than he can catch in a week; still he must go, and he goes. As a result, canneries do not want his labor.

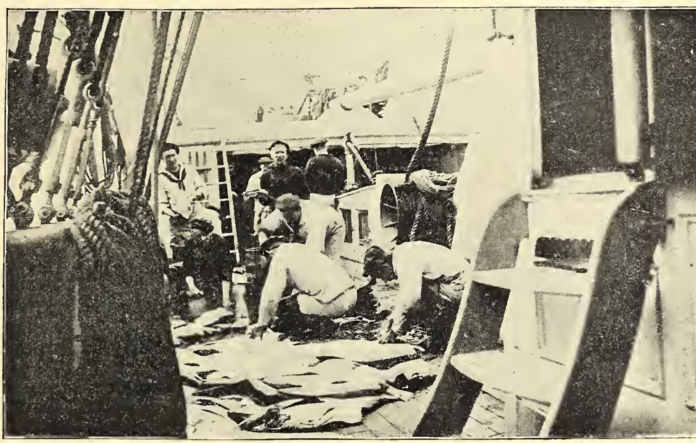
OIL AND GUANO FACTORY AT KILLISNOO.

GILL NET SET BY NATIVES, LAKE EYAK.

FISHING AND COLLECTING BY THE ALBATROSS.

During the cruise, fishing by the ship's force with gill nets, seines, trawls, hand lines, etc., was carried on whenever an opportunity offered. As the instructions also called for information relating to halibut, fishing efforts were largely in that direction.

With gill nets we were only successful at Wrangell (mouth of the Stikine River), Uganuk, Yakutat, and Redfish Bay, localities where the water was not clear. We took the first Dolly Varden trout (*Salvelinus malma*), on June 10 at Metlakahtla, and the first redfish at Karta Bay June 26. At Thorne Bay, on July 5, we took 78 redfish with an average weight of 6 pounds, and 83 Dolly Varden trout averaging $1\frac{1}{2}$ pounds in weight. At Wrangell, in the discolored water, on July 7 we took a number of king and dog salmon and redfish in the same gill net.



Cleaning halibut on deck of steamer *Albatross,* near Killisnoo.

HALIBUT.

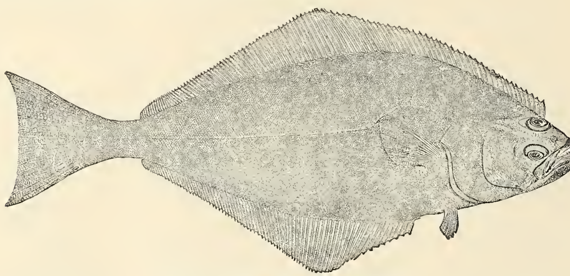
The halibut trawls were set in all localities and every effort made not only to find halibut banks by our own resources, but inquiry was made at every point relating to this subject. The investigations confirm the views of those whom I believe competent to judge, and that is that in southeast Alaska, on the American side of Dixon Entrance, there are no halibut banks for commercial purposes. Halibut were usually taken wherever we went, but nowhere in large numbers except off Killisnoo.

On the southern side of Dixon Entrance, on the plateau of the Queen Charlotte Islands, in the vicinity of Rose Spit and in Hecate Straits, there is comparatively shoal water—that is, under 50 fathoms; in these localities halibut are obtained in considerable numbers throughout the winter months when they are desired in Puget Sound for eastern shipment. In the spring and summer halibut are found scattering

or in clusters throughout all the waters of southeast Alaska, but nowhere do great banks exist, so far as known, on which a vessel might fill up at all times, as can be done on the British Columbia side. They seem to follow the herring, and can also be obtained off any of the canneries, where they probably feed on the offal, and are sufficiently plentiful for local demands.

On Bear Island, at the entrance to Nichols Bay, west of Cape Chacon, southern shore of Prince of Wales Island, is a summer village where the Indians from the surrounding country camp and obtain their supply of halibut for drying. At the time of the visit of the *Albatross* it was occupied by Chief Skowl and part of his tribe of Kasaans. From this chief, who is rather an intelligent Indian, and his headmen, it was learned that off Cape Chacon are a number of spots which the Indians locate by shore ranges and obtain there sufficient halibut for their own use and dry some for trade with the Tsimpseans, from whom they obtain eulachon oil. The Indians will speak with uplifted arms of "hyas pish" (plenty of fish), but their ideas do not go beyond satisfying their own wants. There are no banks here. The halibut are found in spots, and while a vessel might fill up, the fish would soon be cleaned off.

Mr. Clark, proprietor of a saltery at Ketchikan, and a former Cape Ann fisherman, has a schooner and has tried to make a business of marketing halibut in the winter. He has prospected the ground himself, and has extended his inquiry in all directions, and his experience is similar to what has been stated.



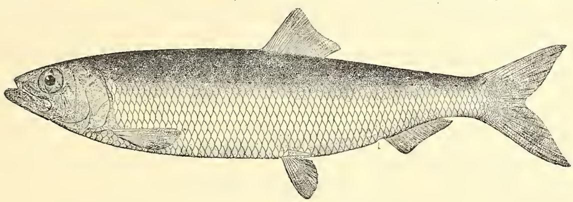
HALIBUT (*Hippoglossus hippoglossus*).

Mr. Miller, of Klinkwan, stated that he had prospected over southeast Alaska, and had nowhere found any banks; that scattering halibut could be found everywhere and in numbers in spots during the summer, and some few in winter, but nowhere in quantities to supply a considerable market.

Clarence Strait is frequently referred to as a great halibut-ground, and tourists who make the southeast Alaska trip are loud in their descriptions of the halibut fisheries off Killisnoo. The steamer *Queen*, which carries Alaska excursionists, makes it a point to give them a few hours of halibut fishing, and sometimes when a good spot is found, or there is a large run of herring, many halibut are taken, while at other times they are not so abundant. When the average tourist gets a 50-pound halibut on his line, he has the experience of his life, and much has been said and written of these halibut grounds. The *Queen* usually fishes between Danger Point and Kenasnow Rocks, off the winter village of Angoon, or in that vicinity. Danger Point is 3 miles from the northern entrance to Killisnoo, and forms the southern point of entrance to

Kootznahoo Inlet. This inlet is noted for its immense schools of herring, and the Alaska Oil and Guano Company, located at Killisnoo, draws a large part of its fish from this inlet.

The ground where it is said the *Queen* usually fishes was fished by the *Albatross* for an hour in from 40 to 50 fathoms of water; one halibut weighing 45 pounds was taken. We then moved off Danger Point, about one-fourth of a mile off the buoy marking the end of the reef, and fished from the vessel and two small boats with 21 hand-lines all told, in from 10 to 30 fathoms, and in $1\frac{1}{2}$ hours obtained 143 halibut, average weight 22 pounds—the smallest 5 pounds, the largest 61 pounds. After this the vessel was moved 1 mile to the northward and continued fishing with hand lines, but nothing was taken. At Danger Point there was a large school of herring running into the inlet at the time of our fishing. The fishing is carried on over the shore shelf and the halibut are attracted by the herring. Small halibut vessels sometimes visit this locality and make part of a load, but there is no certainty at any time.



HERRING (*Clupea pallasi*).

About 4 miles above Danger Point are several halibut spots, and at the entrance to Che-Ik Bay is fairly good ground, but there are no banks that would supply a considerable market. A halibut was taken under the wharf at Killisnoo during the summer of 1897 weighing 450 pounds. It was in shoal water eating salmon heads and would not take the bait, so the hook was placed on the end of a pole and pushed into its mouth. The largest halibut we took weighed 165 pounds. It was caught on a trawl at Chasina Anchorage, Prince of Wales Island. As a rule the halibut are small. The weights of those we took at Killisnoo will give a fair average.

The Indians at Yakutat in the spring of the year, when their stock of dried salmon is running low, fish on spots off Cape Phipps and take all they want for their own use. During a day trawls were set with an experience similar to that in southeast Alaska. A few halibut were caught each time, but here, as in other localities, the lines were filled with dogfish. It is possible that an extended examination might give different results, but for winter fishing it is a long distance from market, with severe weather to be encountered.

We made several trial sets in Sitka Sound and took a few scattering halibut and a great many dogfish.

Several years ago Mr. Robert Bell, who lives at Thorne Bay, spent the months of December, January, February, and part of March in a schooner prospecting for halibut in southeast Alaska. He fished all over the interior waters from Dixon Entrance to Peril Straits, and outside from Salisbury Sound to Dixon Entrance. As he has been a permanent resident of the Territory for some years and is in the fish business, he is well acquainted with the subject so far as it is known. On this

occasion, at several points, from 5,000 to 6,000 pounds of halibut were obtained, but before the load could be made the fish spoiled and had to be thrown overboard. As a last resort, the vessel made for the Queen Charlotte banks, filled up, and went to market.

Our investigation of the halibut fisheries of Alaska was incidental to that of salmon; it would probably occupy several seasons for the thorough examination of this subject alone.

CHARTS OF THE ALASKA SALMON DISTRICTS.

The accompanying charts A and B are designed to show, as completely as possible, the location of the salmon canneries and streams of Alaska, the productive capacity of the streams, and such other information bearing upon the fishing interests of the region as could be appropriately given in this manner.

Several corrections are to be noted, most of them occurring in the lists of canneries printed on the charts.

The following canneries are owned by the Alaska Packers' Association, and should be so noted:

SOUTHEAST ALASKA.

Operated, 1897:
- Pyramid Harbor Packing Co.
- Glacier Packing Co.
- Alaska Salmon Packing and Fur Co.

Reserve, 1897:
- Chilkat Canning Co.

WESTERN ALASKA.

Operated, 1897:
- Bristol Bay Canning Co.
- Arctic Packing Co. at Nushagak.
- Alaska Packing Co.
- Point Roberts Packing Co.
- Arctic Packing Co. at Naknek.
- Ugashik Fishing Station.

Reserve, 1897:
- Nushagak Packing Co.
- Bering Sea Packing Co.

CENTRAL ALASKA.

Operated, 1897:
- Pacific Packing Co.
- Arctic Fishing Co.
- Karluk Packing Co.
- Hume-Aleutian Packing Co.
- Alaska Improvement Co.
- Uganuk Fishing Station.
- Arctic Packing Co. at Alitak.
- Chignik Bay Co.

Reserve, 1897:
- Northern Packing Co.
- Hume Canning and Trading Co.
- Kodiak Packing Co. at Karluk.
- Kodiak Packing Co. at Alitak.
- Chignik Bay Packing Co.

Chart A.—"Kasan Bay" should be "Kasaan Bay."

Abandoned saltery No. 5 should be designated "Morrisey" instead of "No name."

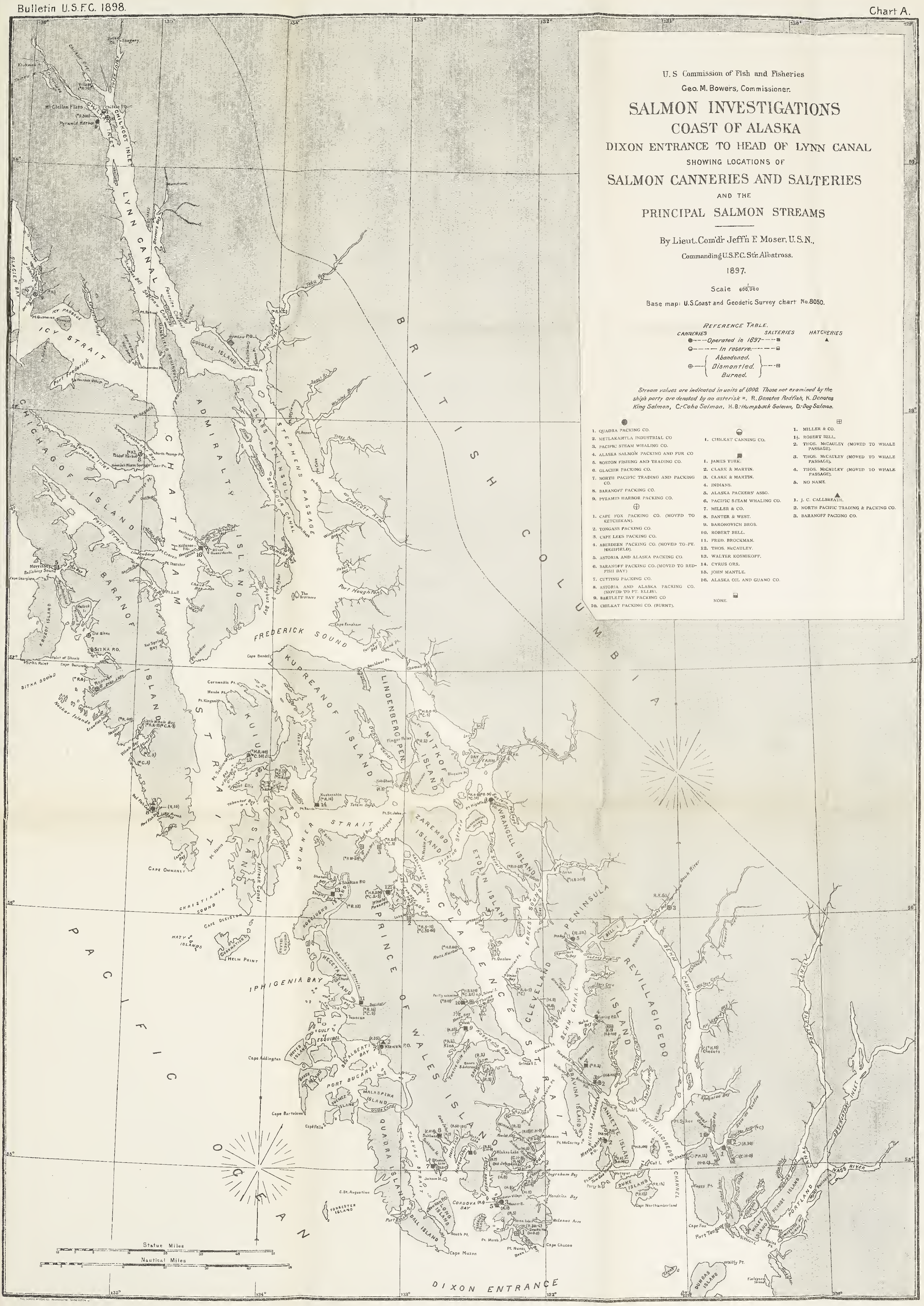
Chart B.—In the list of canneries Cannery No. 4 should be designated "Uganuk Fishing Station."

Reserve cannery No. 9 should be designated "Chignik Bay Packing Co."

Reserve saltery No. 2 should be designated "Uganuk Fishing Station."

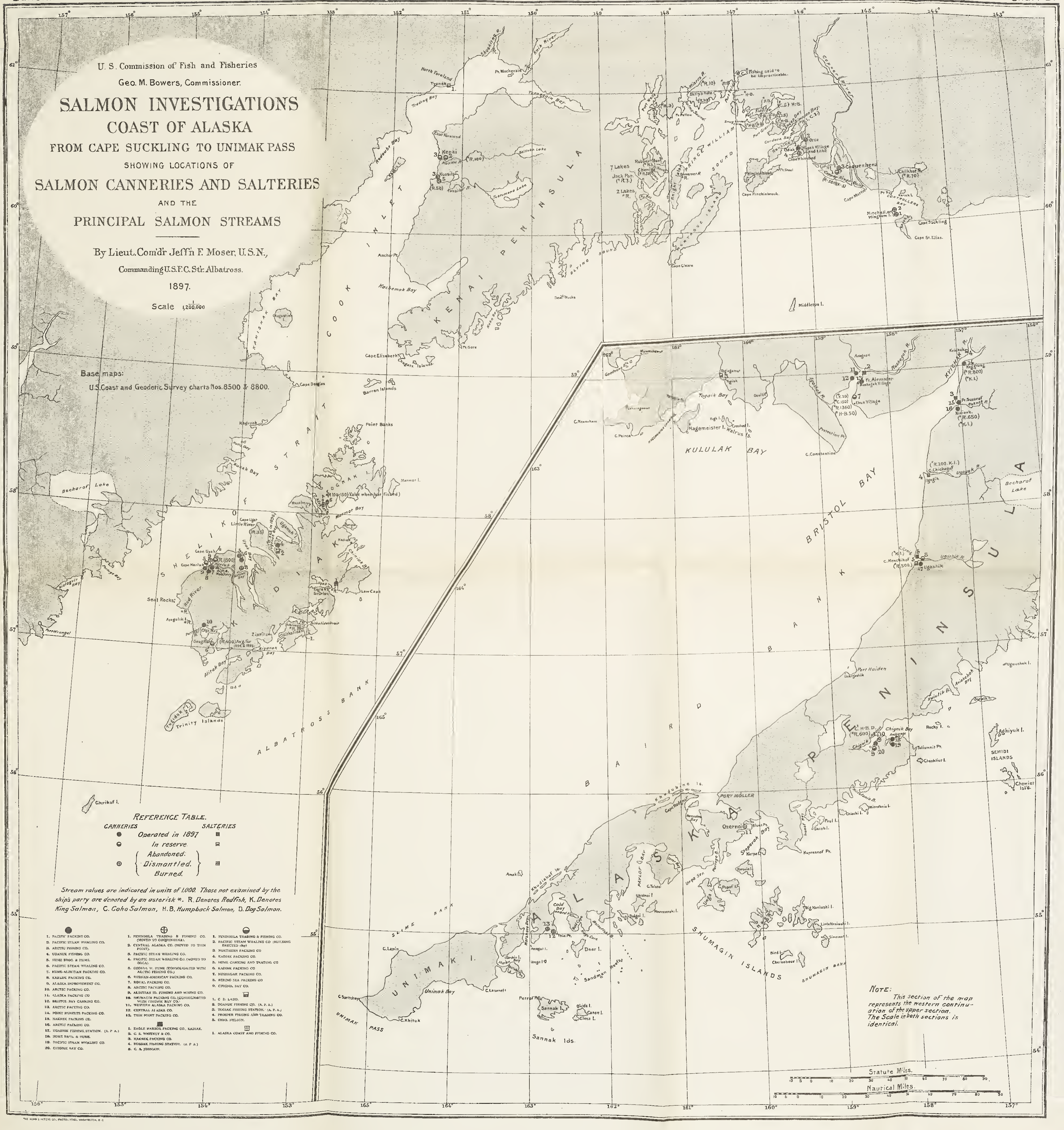
"Alaska Coast and Fishing Co." should be "Alaska Coast Fishing Co."

The name of the company operating reserve canneries 4 and 6 is the "Kodiak Packing Co.," the old spelling of the name of the island being retained, instead of the present accepted spelling "Kadiak."



U. S. Commission of Fish and Fisheries
Geo. M. Bowers, Commissioner.
SALMON INVESTIGATIONS
COAST OF ALASKA
DIXON ENTRANCE TO HEAD OF LYNN CANAL
SHOWING LOCATIONS OF
SALMON CANNERIES AND SALTERIES
AND THE
PRINCIPAL SALMON STREAMS
By Lieut. Com'dr Jeff'n F. Moser, U.S.N.,
Commanding U.S.F.C. Str. Albatross.
1897.
Scale 1/600,000
Base map: U.S. Coast and Geodetic Survey chart No. 8050.
REFERENCE TABLE.
CANNERIES
SALTERIES
HATCHERIES
Operated in 1897
In reserve.
Abandoned.
Dismantled.
Burned.
Stream values are indicated in units of 1,000. Those not examined by the ship's party are denoted by an asterisk *. R. Denotes Redfish, K. Denotes King Salmon, C.-Coho Salmon, H.B.-Humpback Salmon, D.-Dog Salmon.
1. QUADRA PACKING CO.
2. METLAKAHTLA INDUSTRIAL CO
3. PACIFIC STEAM WHALING CO.
4. ALASKA SALMON PACKING AND FUR CO
5. BOSTON FISHING AND TRADING CO.
6. GLACIER PACKING CO.
7. NORTH PACIFIC TRADING AND PACKING CO.
8. BARANOFF PACKING CO.
9. PYRAMID HARBOR PACKING CO.
1. CAPE FOX PACKING CO. (MOVED TO KETCHIKAN).
2. TONGASS PACKING CO.
3. CAPE LEES PACKING CO.
4. ABERDEEN PACKING CO. (MOVED TO PT. HIGHFIELD).
5. ASTORIA AND ALASKA PACKING CO.
6. BARANOFF PACKING CO. (MOVED TO RED-FISH BAY)
7. CUTTING PACKING CO.
8. ASTORIA AND ALASKA PACKING CO. (MOVED TO PT. ELLIS).
9. BARTLETT BAY PACKING CO
10. CHILKAT PACKING CO. (BURNT).
1. CHILKAT CANNING CO.
1. JAMES TURK.
2. CLARK & MARTIN.
3. CLARK & MARTIN.
4. INDIANS.
5. ALASKA PACKERS' ASSO.
6. PACIFIC STEAM WHALING CO.
7. MILLER & CO.
8. BANTER & WEST.
9. BARONOVICH BROS.
10. ROBERT BELL.
11. FRED. BROCKMAN.
12. THOS. McCAULEY.
13. WALTER KOSMIKOFF.
14. CYRUS ORR.
15. JOHN MANTLE.
16. ALASKA OIL AND GUANO CO.
NONE.
1. MILLER & CO.
1½. ROBERT BELL.
2. THOS. McCAULEY (MOVED TO WHALE PASSAGE).
3. THOS. McCAULEY (MOVED TO WHALE PASSAGE).
4. THOS. McCAULEY (MOVED TO WHALE PASSAGE).
5. NO NAME.
1. J. C. CALLBREATH.
2. NORTH PACIFIC TRADING & PACKING CO.
3. BARANOFF PACKING CO.
BRITISH COLUMBIA
LYNN CANAL
ICY STRAIT
CHATHAM STRAIT
ADMIRALTY ISLAND
CHICHAGOF ISLAND
BARANOFF ISLAND
DOUGLAS ISLAND
STEPHENS PASSAGE
FREDERICK SOUND
KUPREANOF ISLAND
KUIU ISLAND
MITKOF ISLAND
SUMNER STRAIT
ZAREMBO ISLAND
WRANGELL ISLAND
ETOLIN ISLAND
PRINCE OF WALES ISLAND
CLARENCE STRAIT
CLEVELAND PENINSULA
REVILLAGIGEDO ISLAND
BEHM CANAL
GRAVINA ISLAND
ANNETTE ISLAND
DUKE ISLAND
DALL ISLAND
DIXON ENTRANCE
PACIFIC OCEAN
Statue Miles
Nautical Miles


161°


U. S. Commission of Fish and Fisheries
Geo. M. Bowers, Commissioner.
SALMON INVESTIGATIONS
COAST OF ALASKA
FROM CAPE SUCKLING TO UNIMAK PASS
SHOWING LOCATIONS OF
SALMON CANNERIES AND SALTERIES
AND THE
PRINCIPAL SALMON STREAMS
By Lieut. Com'dr Jeff'n F. Moser, U.S.N.,
Commanding U.S.F.C. Str. Albatross.
1897.
Scale 1/1,200,000
Base maps:
U.S. Coast and Geodetic Survey charts Nos. 8500 & 8800.
COOK INLET
KENAI PENINSULA
PRINCE WILLIAM SOUND
SHELIKOF STRAIT
KADIAK
AFOGNAK I.
ALBATROSS BANK
Trinity Islands
Chirikof I.
KULULAK BAY
BRISTOL BAY
ALASKA PENINSULA
PORT MÖLLER
SHUMAGIN ISLANDS
SEMIDI ISLANDS
UNIMAK I.
UNIMAK PASS
Sannak Ids.
REFERENCE TABLE.
CANNERIES
SALTERIES
Operated in 1897
In reserve.
Abandoned.
Dismantled.
Burned.
Stream values are indicated in units of 1,000. Those not examined by the ship's party are denoted by an asterisk *. R. Denotes Redfish, K. Denotes King Salmon, C. Coho Salmon, H.B. Humpback Salmon, D. Dog Salmon.
1. PACIFIC PACKING CO.
2. PACIFIC STEAM WHALING CO.
3. ARCTIC FISHING CO.
4. UGANUK FISHING CO.
5. HUME BROS. & HUME.
6. PACIFIC STEAM WHALING CO.
7. HUME-ALEUTIAN PACKING CO.
8. KARLUK PACKING CO.
9. ALASKA IMPROVEMENT CO.
10. ARCTIC PACKING CO.
11. ALASKA PACKING CO.
12. BRISTOL BAY CANNING CO.
13. ARCTIC PACKING CO.
14. POINT ROBERTS PACKING CO.
15. NAKNEK PACKING CO.
16. ARCTIC PACKING CO.
17. UGASHIK FISHING STATION. (A. P. A.)
18. HUME BROS. & HUME.
19. PACIFIC STEAM WHALING CO.
20. CHIGNIK BAY CO.
1. PENINSULA TRADING & FISHING CO. (MOVED TO COQUENHENA).
2. CENTRAL ALASKA CO. (MOVED TO THIN POINT).
3. PACIFIC STEAM WHALING CO.
4. PACIFIC STEAM WHALING CO. (MOVED TO ORCA).
5. GEORGE W. HUME (CONSOLIDATED WITH ARCTIC FISHING CO.)
6. RUSSIAN-AMERICAN PACKING CO.
7. ROYAL PACKING CO.
8. ARCTIC PACKING CO.
9. ALEUTIAN ID. FISHING AND MINING CO.
10. SHUMAGIN PACKING CO. (CONSOLIDATED WITH CHIGNIK BAY CO.)
11. WESTERN ALASKA PACKING CO.
12. CENTRAL ALASKA CO.
13. THIN POINT PACKING CO.
1. EAGLE HARBOR PACKING CO., KADIAK.
2. C. E. WHITNEY & CO.
3. NAKNEK PACKING CO.
4. EGEGAK FISHING STATION. (A. P. A.)
5. C. A. JOHNSON.
1. PENINSULA TRADING & FISHING CO.
2. PACIFIC STEAM WHALING CO. (BUILDING ERECTED 1897)
3. NORTHERN PACKING CO
4. KADIAK PACKING CO.
5. HUME CANNING AND TRADING CO
6. KADIAK PACKING CO
7. NUSHAGAK PACKING CO.
8. BERING SEA PACKING CO
9. CHIGNIK BAY CO.
1. C. D. LADD.
2. UGANUK FISHING CO. (A. P. A.)
3. TOGIAK FISHING STATION. (A. P. A.)
4. PROSPER FISHING AND TRADING CO.
5. CHAS. NELSON.
1. ALASKA COAST AND FISHING CO.
NOTE:
This section of the map represents the western continuation of the upper section. The Scale in both sections is identical.
Statute Miles.
Nautical Miles.

STATISTICS OF THE ALASKAN SALMON INDUSTRY.

The following statistics of the salmon industry of Alaska comprise a continuous record of the business from 1878, the year of its origin, to 1897, when the investigations referred to in this report were made. The data are more comprehensive and useful than any heretofore published, and, besides showing the annual development of the industry in each section, will have a permanent value because of the interesting comparisons that will be possible. For the years 1896 and 1897 there are given detailed statistics of persons employed, capital invested, apparatus used, salmon utilized, and canned products prepared. Special statistics of the salmon salting conducted by independent establishments are shown for 1897.

The total quantity of salmon canned in Alaska during the twenty years ending in 1897, as shown by the following table, was 7,508,358 cases, each case holding 48 one-pound cans. The net weight of the fish thus prepared was 360,401,184 pounds, while the gross weight of the salmon required for this pack was over 500,000,000 pounds. The average annual pack was 375,418 cases, but during the last ten years of the period in question the average quantity of salmon canned was 691,743 cases and the total gross weight of the fish utilized for canning was over 470,000,000 pounds. Thus, between 1888 and 1897 the Alaskan waters yielded an average yearly output of 47,000,000 pounds of salmon for canning purposes, in addition to large quantities which were salted.

Table showing by years and districts the salmon-canning operations in Alaska from 1878 to 1897.

Year.	Southeast Alaska.	Prince William Sound and Copper River.	Cook Inlet.	Kadiak and Chignik.	Bering Sea.	Grand totals, all Alaska.
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
1878	8,159					8,159
1879	12,530					12,530
1880	6,539					6,539
1881	8,977					8,977
1882	11,501		6,044	4,200		21,745
1883	18,040		14,818	13,479		46,337
1884	19,189		21,141	20,156	400	60,886
1885	10,828		19,217	33,470	14,000	77,515
1886	18,160		28,433	46,150	48,822	141,565
1887	31,462		30,765	71,750	72,700	206,677
1888	81,128		42,451	198,650	89,886	412,115
1889	136,760	24,204	50,494	386,753	115,985	714,196
1890	142,901	42,194	28,655	350,451	118,390	682,591
1891	156,615	68,091	58,997	384,279	133,418	801,400
1892	115,722		20,741	274,755	63,499	474,717
1893	136,053	76,998	31,665	291,152	107,786	643,654
1894	142,544	78,663	34,033	322,356	108,844	686,440
1895	148,476	59,494	36,188	232,237	150,135	626,530
1896	262,381	92,866	34,767	358,357	218,336	966,707
1897	271,867	52,057	32,532	298,310	254,312	909,078
Total	1,739,832	494,567	490,941	3,286,505	1,496,513	7,508,358

For four years after salmon canning was begun in Alaska it was confined to the southeastern part of the Territory; in 1882 the business was inaugurated in the Cook Inlet and the Kadiak regions; two years later canning commenced in Bering Sea, and in 1889 in Prince William Sound. In all of these sections the industry has continued and has undergone a great increase, so that the pack of 1897 was larger than that of any previous year except 1896.[1] Up to and including 1897 more than two-fifths of the canned products, namely, 3,286,505 cases, had come from the Kadiak and Chignik district; somewhat more than one-fifth, or 1,739,832 cases, from southeast Alaska, and a little less than one-fifth, or 1,496,513 cases, from Bering Sea. The condensed tables showing the

[1] The Alaska salmon pack of 1898 was about 960,000 cases.

annual pack in each region and the proportion of the different sections in the value of the canned products afford an interesting study of the seasonal fluctuations of the business.

The growth of the salmon-canning business, as indicated by the number of canneries in operation each year, is shown in the following table. The acme of the business was reached in 1889, when 37 canneries were run. In 1892, for reasons elsewhere stated, the active canneries were reduced to 15, and since that year there have been numbers of canneries held in reserve in the most important districts. Owing to the establishment of new canneries and the reopening of old ones, the plants operated in 1896 and 1897 were more numerous than in any season since 1891.

Table showing by years the number of canneries operated in each district of Alaska from 1878 to 1897.

Years.	Southeast Alaska.	Prince William Sound and Copper River.	Cook Inlet.	Kadiak and Chignik.	Bering Sea.	Total.
1878	2					2
1879	2					2
1880	1					1
1881	1					1
1882	1		1	1		3
1883	4		1	1		6
1884	4		1	1	1	7
1885	3		1	1	1	6
1886	4		1	1	3	9
1887	5		1	1	3	10
1888	6		2	4	4	16
1889	12	4	2	15	4	37
1890	12	3	2	14	4	35
1891	11	3	3	8	5	30
1892	7		1	5	2	15
1893	8	3	1	7	3	22
1894	7	3	1	6	4	21
1895	7	3	1	6	6	23
1896	9	3	1	8	8	29
1897	9	2	1	10	7	29

The number of salmon canneries in operation in 1897 was 29, divided as follows among the different districts: Southeast Alaska, 9; Prince William Sound and Copper River, 2; Cook Inlet, 1; Kadiak and Chignik, 10, and Bering Sea, 7. In the previous year, also, 29 canneries were operated, 9 being in southeast Alaska, 3 on Prince William Sound and Copper River, 1 on Cook Inlet, 8 at Kadiak and Chignik, and 8 in Bering Sea.

The number of persons employed in the Alaskan salmon-canning business in 1897 was 5,252. Of these, 1,148 were white fishermen, 759 native fishermen, 312 white cannery employes, 439 native cannery hands, 2,268 Chinese cannery hands, and 326 hatchery men, crews of cannery launches and other vessels, and various other employees. The persons employed in various capacities in each district numbered as follows: Southeast Alaska, 1,829; Prince William Sound and Copper River, 364; Cook Inlet, 173; Kadiak and Chignik, 1,577, and Bering Sea, 1,309.

The amount of invested capital represented by the Alaskan salmon industry is very large. The value of the vessels, boats, fishing gear, buildings, machinery, etc., including the canneries not operated but held in reserve, aggregated approximately $3,623,200 in 1897, apportioned as follows among the different districts: Southeast Alaska, $597,400; Prince William Sound and Copper River, $263,500; Cook Inlet, $154,300; Kadiak and Chignik, $1,741,000, and Bering Sea, $867,000. By far the largest item in the investment was the cannery buildings and equipment, which had a value of $2,630,860. The other leading items were vessels and boats, $836,100; 544 gill nets, $69,470; 48 traps, $48,050, and 133 seines, $38,680.

Table showing the output of the salmon canneries of Alaska from 1878 to 1897.

Name of company and location of cannery.	1878.	1879.	1880.	1881.	1882.	1883.	1884.
SOUTHEAST ALASKA.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Cape Fox Packing Co., north shore Boca de Quadra						Packs unknown.	
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island	5,402	6,675	6,539	8,977	11,501	8,240	6,189
Cutting Packing Co., Old Sitka, Baranof Island	2,757	5,855	Closed.	Closed.	([1])		
Chilkat Packing Co., east shore Chilkat Inlet						6,000	7,000
Northwest Trading Co., Pyramid Harbor, Chilkat Inlet						3,800	6,000
Totals of annual packs in southeast Alaska	8,159	12,530	6,539	8,977	11,501	[2] 18,040	[2] 19,189
COOK INLET.							
Alaska Packing Co., Kussilof River, Cook Inlet					6,044	14,818	21,141
KADIAK AND CHIGNIK.							
Karluk Packing Co., Karluk, Kadiak Island					4,200	13,479	20,156
BERING SEA.							
Arctic Packing Co., Nusbagak River, Bristol Bay							[3] 400

Name of company and location of cannery.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
SOUTHEAST ALASKA.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Cape Fox Packing Co., north shore Boca de Quadra	Packs unknown.		New	company;	moved to	Ketchikan in 1887.	
Tongass Packing Co., Ketchikan, Tongass Narrows			5,500	11,000	13,000	Burnt, Aug., 1889.	
Metlakahtla Industrial Co., Metlakahtla, Annette Island						[3] 500	7,000
Alaska Salmon Packing and Fur Co., Loring, Naha Bay				18,771	28,862	23,024	22,786
Boston Fishing and Trading Co., Yes or McDonald Bay					4,500	9,343	17,365
Cape Lees Packing Co., Burroughs Bay, Behm Canal				5,732	10,574	10,823	
Aberdeen Packing Co., Stikine River			3,400	14,000	Moved; new company.		
Glacier Packing Co., Point Highfield, Wrangell Island					13,800	14,600	15,876
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island	8,428	7,860	9,562	12,325	11,370	10,188	9,256
Baranoff Packing Co., Redoubt, Baranof Island					4,454	10,123	Moved.
Baranoff Packing Co., Redfish Bay, Baranof Island							7,949
Astoria and Alaska Packing Co., Freshwater Bay, Chichagof Island					Unknown.	Moved.	
Astoria and Alaska Packing Co., Point Ellis, Kuiu Island						8,000	16,200
Bartlett Bay Packing Co., Bartlett Bay, Icy Straits					4,300	12,000	7,600
Chilkat Packing Co., east shore Chilkat Inlet	2,400	1,700	8,000	Closed.	13,500	15,000	13,369
Chilkat Canning Co., Chilkat Village, Chilkat Inlet					19,000	17,000	20,914
Northwest Trading Co., Pyramid Harbor, Chilkat Inlet	Closed.	8,600	5,000	New Co.			
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet				19,300	[4] 13,400	12,300	18,300
Totals of annual packs in southeast Alaska	[2] 10,828	[2] 18,160	31,462	81,128	[2] 136,760	142,901	156,615
PRINCE WILLIAM SOUND AND COPPER RIVER.							
Central Alaska Co., Little Kayak Island, Gulf of Alaska					1,600	Moved to Thin Point	
Peninsula Trading and Fishing Co., Little Kayak Island, Gulf of Alaska					2,540	14,200	Moved.
Peninsula Trading and Fishing Co., Coquenhena, Copper River Delta							18,085
Pacific Packing Co., Odiak, Prince William Sound					5,064	13,716	27,209
Pacific Steam Whaling Co., Odiak, Prince William Sound					15,000	14,278	22,797
Totals of annual packs in Prince William Sound and Copper River					24,204	42,194	68,091
COOK INLET.							
Northern Packing Co., Kenai				12,996	18,712	15,905	18,254
George W. Hume, Kussilof River						12,750	21,586
Alaska Packing Co., Kussilof River	NewCo.						
Arctic Fishing Co., Kussilof River	19,217	28,433	30,765	29,455	31,782	([5])	19,157
Totals of annual packs in Cook Inlet	19,217	28,433	30,765	42,451	50,494	28,655	58,997
KADIAK AND CHIGNIK.							
Kodiak Packing Co., Karluk, Kadiak Island				26,146	30,287	43,060	41,000
Hume Packing Co., Karluk, Kadiak Island					28,000	37,613	36,247
Aleutian Islands Fishing and Mining Co., Karluk, Kadiak Island				33,700	53,551	40,335	[6] 39,312
Karluk Packing Co., Karluk, Kadiak Island	33,470	46,150	71,750	101,304	62,057	40,306	66,483
Alaska Improvement Co., Karluk, Kadiak Island					25,600	26,000	26,000
Arctic Packing Co., Alitak Bay, Kadiak Island					13,850	17,800	26,600
Kodiak Packing Co., Alitak Bay, Kadiak Island					12,535	16,347	([7])
Arctic Packing Co., Larsen Cove, Uyak Bay				37,500	44,200	37,600	[8] 41,000
Royal Packing Co., Afognak Island					16,412	9,926	([9])
Russian-American Packing Co., Afognak Island					25,500	26,500	[10] 25,000
Chignik Bay Co., Chignik Bay, Alaska Peninsula					21,500	14,455	24,730
Shumagin Packing Co., Chignik Bay, Alaska Peninsula					11,200	[11] 14,455	[11] 24,832
Chignik Bay Packing Co., Chignik Bay, Alaska Peninsula					10,500	[11] 14,455	[11] 24,780
Western Alaska Packing Co., Ozernoi, Stepovak Bay, Alaska Peninsula					6,400	2,198	Aband'd.
Thin Point Packing Co., Thin Point, Alaska Peninsula					25,161	2,401	4,206
Central Alaska Co., Thin Point, Alaska Peninsula						7,000	4,089
Totals of annual packs in Kadiak and Chignik	33,470	46,150	71,750	198,650	386,753	350,451	384,279
BERING SEA.							
Arctic Packing Co., Nushagak River, Bristol Bay	14,000	19,000	24,000	25,000	25,000	33,000	30,883
Alaska Packing Co., Nushagak River, Bristol Bay		16,500	27,500	19,000	30,000	31,000	31,077
Bristol Bay Canning Co., Nushagak River, Bristol Bay		13,322	21,200	30,000	33,221	30,400	37,100
Nushagak Packing Co., Nushagak River, Bristol Bay				15,886	27,764	23,990	30,363
Bering Sea Packing Co., Ugashik River, Bristol Bay							3,995
Totals of annual packs in Bering Sea	14,000	48,822	72,700	89,886	115,985	118,390	133,418

[1] Machinery moved; site abandoned.

[2] The records for the southeast Alaska district for 1883, 1884, 1885, 1886, and 1889 lack the pack of one small cannery each, the output of which can not be ascertained.

[3] Experimental pack.

[4] Burnt and rebuilt in spring.

[5] Vessel lost; closed.

[6] Packed in cannery of Hume Packing Co. at Karluk.

[7] Consolidated with the Arctic Packing Company.

[8] Packed in cannery of Kodiak Packing Company at Karluk.

[9] The quota of fish for the Royal Packing Company at Afognak was packed by the Karluk Packing Company at Karluk.

[10] Packed in cannery of Alaska Improvement Company at Karluk.

[11] Packed in cannery of Chignik Bay Company.

Table showing the output of the salmon canneries of Alaska from 1878 to 1897—Continued.

Name of company and location of cannery.	1892.	1893.	1894.	1895.	1896.	1897.
SOUTHEAST ALASKA.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Quadra Packing Co., Mink Bay, Boca de Quadra					8,000	24,500
Metlakahtla Industrial Co., Metlakahtla, Annette Island	11,125	12,500	14,000	12,000	17,650	15,490
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island					27,442	34,388
Alaska Salmon Packing and Fur Co., Loring, Naha Bay	21,446	25,153	26,869	32,554	61,467	62,040
Boston Fishing and Trading Co., Yes or McDonald Bay	13,734	15,102	12,000	14,100	24,100	22,300
Cape Lees Packing Co., Burroughs Bay, Behm Canal	Closed.	Closed.	Dismantled.			
Glacier Packing Co., Point Highfield, Wrangell Island	Closed.	22,728	25,250	27,416	44,233	45,918
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island	10,194	12,595	14,455	12,228	16,675	15,705
Baranoff Packing Co., Redfish Bay, Baranof Island	10,259	9,889	11,189	14,805	15,358	14,070
Astoria and Alaska Packing Co., Point Ellis, Kuiu Island	Burnt.[1]					
Bartlett Bay Packing Co., Bartlett Bay, Icy Straits	Closed.	Closed.	Dismantled.			
Chilkat Packing Co., east shore Chilkat Inlet	Burnt.					
Chilkat Canning Co., Chilkat Village, Chilkat Inlet	20,000	24,418	Closed.	Closed.	Closed.	Closed.
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet	28,964	13,668	38,781	35,373	47,456	37,456
Totals of annual packs in southeast Alaska	115,722	136,053	142,544	148,476	262,381	271,867
PRINCE WILLIAM SOUND AND COPPER RIVER.						
Peninsula Trading and Fishing Co., Coquenhena, Copper River Delta	Closed.	15,270	15,000	15,000	20,672	Closed.
Pacific Packing Co., Odiak, Prince William Sound	Closed.	28,999	28,378	21,453	39,873	23,301
Pacific Steam Whaling Co., Odiak, Prince William Sound	Closed.	32,729	35,285	Moved.		
Pacific Steam Whaling Co., Orca, Prince William Sound				23,041	32,321	28,756
Totals of annual packs in Prince William Sound and Copper River		76,998	78,663	59,494	92,866	52,057
COOK INLET.						
Northern Packing Co., Kenai	Closed.	Closed.	Closed.	Closed.	Closed.	Closed.
Pacific Steam Whaling Co., Kenai						(2)
George W. Hume, Kussilof River	20,741	Closed.	(3)			
Arctic Fishing Co., Kussilof River	Closed.	31,665	34,033	36,188	34,767	32,532
Totals of annual packs in Cook Inlet	20,741	31,665	34,033	36,188	34,767	32,532
KADIAK AND CHIGNIK.						
Kodiak Packing Co., Karluk, Kadiak Island	Closed.	30,138	Closed.	Closed.	Closed.	Closed.
Aleutian Islands Fishing and Mining Co., Karluk, Kadiak Island	Consol.					
Hume Aleutian Packing Co., Karluk, Kadiak Island	76,233	59,959	79,000	47,500	70,320	49,633
Karluk Packing Co., Karluk, Kadiak Island	75,416	59,220	79,000	48,379	68,495	54,777
Alaska Improvement Co., Karluk, Kadiak Island	52,098	43,076	54,300	35,700	87,613	49,852
Hume Canning and Trading Co., Tanglefoot Bay, near Karluk		15,429	26,984	15,277	Closed.	Closed.
Arctic Packing Co., Alitak Bay, Kadiak Island	21,077	25,777	27,720	15,331	23,155	37,401
Kodiak Packing Co., Alitak Bay, Kadiak Island		Mach. moved.				
Pacific Steam Whaling Co., Uyak Anchorage, Kadiak Island						17,000
Hume Bros. & Hume, Uyak Anchorage, Kadiak Island						13,375
Arctic Packing Co., Larsen Cove, Uyak Bay	Closed.	Closed.	Closed.	Closed.	Mach. moved.	
Uganuk Fishing Station, Uganuk Bay, Kadiak Island					21,005	2,113
Royal Packing Co., Afognak Island	Closed; inoperative by President's proclamation creating a Fish Commission reservation.				Mach. moved.	
Russian-American Packing Co., Afognak Island					Disman.	
Chignik Bay Co., Chignik Bay, Alaska Peninsula	49,931	57,553	55,352	70,050	48,361	38,159
Shumagin Packing Co., Chignik Bay, Alaska Peninsula	Consol.					
Chignik Bay Packing Co., Chignik Bay, Alaska Peninsula	Closed.	Closed.	Closed.	Closed.	Closed.	Closed.
Hume Bros. & Hume, Chignik Bay, Alaska Peninsula					17,893	12,000
Pacific Steam Whaling Co., Chignik Bay, Alaska Peninsula					21,515	24,000
Thin Point Packing Co., Thin Point, Alaska Peninsula	Closed.	Closed.	Disman.			
Central Alaska Co., Thin Point, Alaska Peninsula	Closed.	Closed.	Closed.	Disman.		
Totals of annual packs in Kadiak and Chignik	274,755	291,152	322,356	232,237	358,357	298,310
BERING SEA.						
Arctic Packing Co., Nushagak River, Bristol Bay	Closed.	35,848	30,413	33,631	35,676	35,890
Alaska Packing Co., Nushagak River, Bristol Bay	31,859	37,188	30,038	34,632	39,115	37,849
Bristol Bay Canning Co., Nushagak River, Bristol Bay	31,640	34,750	30,999	33,434	38,314	34,117
Nushagak Packing Co., Nushagak River, Bristol Bay	Closed.	Closed.	Closed.	Closed.	Closed.	Closed.
Point Roberts Packing Co., Kvichak River, Bristol Bay					29,730	55,508
Arctic Packing Co., Naknek River, Bristol Bay				22,731	27,133	34,676
Naknek Packing Co., Naknek River, Bristol Bay				13,700	8,600	18,000
Bering Sea Packing Co., Ugashik River, Bristol Bay	Closed.	Closed.	17,394	12,007	20,004	Closed.
Ugashik Fishing Station, Ugashik River, Bristol Bay					19,764	38,272
Totals of annual packs in Bering Sea	63,499	107,786	108,844	150,135	218,336	254,312

[1] Burnt May 1. [2] Buildings erected. [3] Consolidated with the Arctic Fishing Company.

Summary showing output of Alaskan salmon-packing companies since organization, together with their ownership in 1897.

Name of company and location of cannery.	Owned in 1897 by—	Total output since organization.
SOUTHEAST ALASKA.		*Cases.*
Cape Fox Packing Co., Boca de Quadra	Defunct	....
Quadra Packing Co., Boca de Quadra	Same Co	32,500
Tongass Packing Co., Tongass Narrows	Defunct	29,500
Metlakahtla Industrial Co., Annette Isl'd	Same Co	90,265
Pacific Steam Whaling Co., Prince of Wales Island.	do	61,830
Alaska Salmon Packing and Fur Co., Naha Bay.	A. P. A	322,972
Boston Fishing and Trading Co., Yes Bay	Same Co	132,544
Cape Lees Packing Co., Burroughs Bay	Defunct	27,129
Aberdeen Packing Co., Stikine River	do	17,400
Glacier Packing Co., Wrangell Island	A. P. A	209,821
North Pacific Trading and Packing Co., Klawak.	Same Co	204,364
Baranoff Packing Co., Redoubt, Baranof Island.	Defunct	14,577
Baranoff Packing Co., Redfish Bay, Baranof Island.	Same Co	83,519
Cutting Packing Co., Old Sitka, Baranof Island.	Defunct	8,612
Astoria and Alaska Packing Co., Chichagof Island.	Defunct	....
Astoria and Alaska Packing Co., Kuiu Isl'd	Defunct	24,200
Bartlett Bay Packing Co., Bartlett Bay	do	23,900
Chilkat Packing Co., Chilkat Inlet	A. P. A	66,969
Chilkat Canning Co., Chilkat Inlet	do	101,332
Northwest Trading Co., Chilkat Inlet	Defunct	23,400
Pyramid Harbor Packing Co., Chilkat Inlet	A. P. A	264,998
Total		[1] 1,739,832
PRINCE WILLIAM SOUND AND COPPER RIVER.		
Central Alaska Co., Little Kayak Island	Defunct	1,600
Peninsula Trading and Fishing Co., Little Kayak Island.	Defunct	16,740
Peninsula Trading and Fishing Co., Coquenhena.	P. S. W. Co	84,027
Pacific Packing Co., Odiak	A. P. A	187,993
Pacific Steam Whaling Co., Odiak	Defunct	120,089
Pacific Steam Whaling Co., Orca	Same Co	84,118
Total		494,567
COOK INLET.		
Northern Packing Co., Kenai	A. P. A	65,867
Pacific Steam Whaling Co., Kenai	Same Co	....
George W. Hume, Kussilof River	A. P. A	55,077
Alaska Packing Co., Kussilof River	Defunct	42,003
Arctic Fishing Co., Kussilof River	A. P. A	327,994
Total		490,941
KADIAK AND CHIGNIK.		*Cases.*
Kodiak Packing Co., Karluk	A. P. A	170,631
Hume Packing Co., Karluk	Defunct	101,860
Aleutian Islands Fishing and Mining Co., Karluk.	Defunct	166,898
Hume-Aleutian Packing Co., Karluk	A. P. A	382,645
Karluk Packing Co., Karluk	do	844,642
Alaska Improvement Co., Karluk	do	400,239
Hume Canning and Trading Co., Tanglefoot Bay, near Karluk.	do	57,690
Arctic Packing Co., Alitak Bay	do	208,711
Kodiak Packing Co., Alitak Bay	do	28,882
Pacific Steam Whaling Co., Uyak Anchorage.	Same Co	17,000
Hume Bros. & Hume, Uyak Anchorage.	do	13,375
Arctic Packing Co., Larsen Cove	A. P. A	160,300
Uganuk Fishing Station, Uganuk Bay	do	23,118
Royal Packing Co., Afognak Island	do	26,338
Russian-American Packing Co., Afognak Island.	do	77,000
Chignik Bay Co., Chignik Bay	do	380,091
Shumagin Packing Co., Chignik Bay	Defunct	50,487
Chignik Bay Packing Co., Chignik Bay	A. P. A	49,735
Hume Bros. & Hume, Chignik Bay	Same Co	29,893
Pacific Steam Whaling Co., Chignik Bay.	do	45,515
Western Alaska Packing Co., Ozernoi, Stepovak Bay.	Defunct	8,598
Thin Point Packing Co., Thin Point	do	31,768
Central Alaska Co., Thin Point	do	11,089
Total		3,286,505
BERING SEA.		
Arctic Packing Co., Nushagak River	A. P. A	342,741
Alaska Packing Co, Nushagak River	do	365,758
Bristol Bay Canning Co., Nushagak River.	do	368,497
Nushagak Packing Co., Nushagak River.	do	98,003
Point Roberts Packing Co., Kvichak River.	do	85,238
Arctic Packing Co., Naknek River	do	84,540
Naknek Packing Co., Naknek River	Same Co	40,300
Bering Sea Packing Co., Ugashik River	A. P. A	53,400
Ugashik Fishing Station, Ugashik River.	do	58,036
Total		1,496,513
Grand total		7,508,358

[1] The records for the southeast Alaska district for 1883, 1884, 1885, 1886, and 1889 lack the pack of one small cannery each, the output of which can not be ascertained.

Annual per cent value of total salmon pack (canned) of Alaska for each district, from beginning of canning operations, 1878, to close of season of 1897.

Years.	Southeast Alaska.			Prince William Sound and Copper River.	Cook Inlet.	Kadiak and Chignik.			Bering Sea.
	Lower.	Upper.	Total.			Kadiak and Afognak islands.	Alaska Peninsula.	Total.	
1878	66.2	33.8	100	....	....	....	....	....	....
1879	53.3	46.7	100	....	....	....	....	....	....
1880	100	....	100	....	....	....	....	....	....
1881	100	....	100	....	....	....	....	....	....
1882	52.9	....	52.9	....	27.8	19.3	....	19.3	....
1883	17.8	21.2	39	....	32	29	....	29	....
1884	10.2	21.3	31.5	....	34.7	33.1	....	33.1	0.7
1885	10.9	3.1	14	....	24.8	43.2	....	43.2	18
1886	5.5	7.3	12.8	....	20.1	32.6	....	32.6	34.5
1887	8.9	6.3	15.2	....	14.9	34.7	....	34.7	35.2
1888	15	4.7	19.7	....	10.3	48.2	....	48.2	21.8
1889	11.5	7.6	19.1	3.4	7.1	43.7	10.5	54.2	16.2
1890	10	10.9	20.9	6.2	4.2	43.3	8	51.3	17.4
1891	9	10.5	19.5	8.5	7.4	37.7	10.3	48	16.6
1892	11.9	12.5	24.4	....	4.3	47.4	10.5	57.9	13.4
1893	13.7	7.4	21.1	12	4.9	36.3	8.9	45.2	16.8
1894	13.5	7.3	20.8	11.4	5	38.9	8.1	47	15.8
1895	15.7	8	23.7	9.6	5.7	25.9	11.2	37.1	23.9
1896	20.6	6.5	27.1	9.6	3.6	28	9.1	37.1	22.6
1897	24.2	5.7	29.9	5.7	3.6	24.6	8.2	32.8	28
Average for 20 years	15	8.2	23.2	6.6	6.5	35.7	8.1	43.8	19.9

Table showing the salmon pack of the Alaska canneries for 1896.

Name of company and location of cannery.	Daily capacity (cases).	Redfish.				Cohoes.			
		Number of cases packed.	Average number per case.	Commenced packing.	Finished packing.	Number of cases packed.	Average number per case.	Commenced packing.	Finished packing.
Quadra Packing Co., Mink Bay, Boca de Quadra	500	8,000							
Metlakahtla Industrial Co., Metlakahtla, Annette Island	600	8,730	12	July 1	Sept. 5	1,500	6 to 7	Aug. 1	Sept. 10
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island.	800	15,386	10.3	July 10	Sept. 20	5,654	7	Aug. 1	Sept. 26
Alaska Salmon Packing and Fur Co., Loring, Naba Bay	1,800	19,621	11	June 19	Aug. 31	3,029	9	Aug. 5	Sept. 15
Boston Fishing and Trading Co., Yes or McDonald Bay	800	7,000	9	July 11	Aug. 25	2,100	6	Aug. 20	Sept. 15
Glacier Packing Co., Point Highfield, Wrangell Island	1,500	12,584	9.88	June 22	Aug. 31	11,010	8.3	July 1	Sept. 16
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island.	500	14,089	13	June 19	Aug. 23	2,073	8 to 9	Aug. 15	Sept. 25
Baranoff Packing Co., Redfish Bay, Baranof Island	500	9,338	11	June 22	Aug. 20	2,157	5	Aug. 15	Sept. 21
Pyramid Harbor Packing Co., Pyramid Harbor, Cbilkat Inlet.	1,600	44,044	10.3	June 25	Sept. 12	612	7.5	Aug. 28	Sept. 12
Peninsula Trading and Fishing Co., Coquenhona, Copper River Delta.	800	20,558	10	May 20	July 25				
Pacific Packing Co., Odiak, Prince William Sound	1,500	29,500	9.6	May 10	Aug. 30	217	9	Aug. 9	Aug. 27
Pacific Steam Whaling Co., Orca, Prince William Sound	1,500	23,445	9.5	May 15	July 31	4,021	7.5	Aug. 13	Sept. 14
Arctic Fishing Co., Kussilof River, Cook Inlet	1,500	23,367	13.2	May 25	Aug. 14	2,300	12	July 20	Aug. 14
Hume-Aleutian Packing Co., Karluk, Kadiak Island	2,600	70,320	12	June 5	Sept. 18				
Karluk Packing Co., Karluk, Kadiak Island	2,600	68,495	12	June 5	Sept. 18				
Alaska Improvement Co., Karluk, Kadiak Island	1,500	87,613	12	June 10	Sept. 15				
Arctic Packing Co., Alitak Bay, Kadiak Island	1,500	23,155	12	June 11	Aug. 28				
Uganuk Fishing Station, Uganuk Bay, Kadiak Island	1,400	21,005	10	June 10	July 26				
Cbignik Bay Co., Chignik Lagoon, Chignik Bay	2,600	45,281	10	June 16	Aug. 25	2,204	11	Aug. 18	Sept. 5
Hume Bros. & Hume, Anchorage Bay, Chignik Bay	800	17,643	10	June 16	Aug. 25	50	11	Scattering through season.	
Pacific Steam Whaling Co., Anchorage Bay, Chignik Bay	800	18,500	10	June 18	Aug. 25	90	11	July 18	Aug. 15
Arctic Packing Co., Nushagak River, Bering Sea	2,000	No data for 1896.							
Alaska Packing Co., Nushagak River, Bering Sea	2,000								
Bristol Bay Canning Co., Nushagak River, Bering Sea	2,000								
Point Roberts Packing Co., Kvicbak River, Bering Sea	2,000								
Arctic Packing Co., Naknek River, Bering Sea	1,800								
Naknek Packing Co., Naknek River, Bering Sea	1,500								
Bering Sea Packing Co., Ugashik River, Bering Sea	1,200								
Ugashik Fishing Station, Ugasbik River, Bering Sea	1,800								

Name of company and location of cannery.	Humpbacks.				King and dog salmon.			
	Number of cases packed.	Average number per case.	Commenced packing.	Finished packing.	Number of cases packed.	Average number per case.	Commenced packing.	Finished packing.
Metlakahtla Industrial Co., Metlakahtla, Annette Island	7,420	21 to 22	July 21	Aug. 22				
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island.	6,402	19	July 21	Aug. 29				
Alaska Salmon Packing and Fur Co., Loring, Naha Bay	38,365	20 to 21	July 18	Aug. 31	Dog, 452	6.5	July 18	Aug. 6
Boston Fishing and Trading Co., Yes or McDonald Bay	15,000	16	Aug. 5	Sept. 5				
Glacier Packing Co., Point Highfield, Wrangell Island	19,652	18.4	July 1	Aug. 29	King, 987	4	May 15	June 22
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island.	513	22	July 24	Aug. 10				
Baranoff Packing Co., Redfish Bay, Baranof Island	3,863	23	July 19	Aug. 31				
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet.					King, 2,800	3.1	May 25	June 25
Peninsula Trading and Fishing Co., Coquenhena, Copper River Delta.					King, 114	2.5	May 20	June 1
Pacific Packing Co., Odiak, Prince William Sound	9,940	22	July 8	Aug. 24	King, 216	3.8	May 6	June 14
Pacific Steam Whaling Co., Orca, Prince William Sound	4,855	18.7	July 9	July 26				
Arctic Fisbing Co., Kussilof River, Cook Inlet	2,100	18	July 15	Aug. 10	King, 7,000	2.6	May 25	July 25
Chignik Bay Co., Chignik Lagoou, Chignik Bay	[1]876		Aug. 5	Sept. 1				
Hume Bros. & Hume, Anchorage Bay, Chignik Bay	200	20	July 20	Aug. 20				
Pacific Stoam Whaling Co., Anchorago Bay, Chignik Bay	2,800	20	July 20	Aug. 20	King, 125	3	Scattering through season.	

[1] Humpback and dog salmon.

Table showing the salmon pack of the Alaska canneries for 1897.

Name of company and location of cannery.	Daily capacity (cases).	Redfish. Number of cases packed.	Redfish. Average number per case.	Redfish. Commenced packing.	Redfish. Finished packing.	Cohoes. Number of cases packed.	Cohoes. Average number per case.	Cohoes. Commenced packing.	Cohoes. Finished packing.
Quadra Packing Co., Mink Bay, Boca de Quadra	500	7,500				3,000			
Metlakahtla Industrial Co., Metlakahtla, Annette Island	600	7,090		July 8	Sept. 2	840		July 20	Sept. 2
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island.	800	13,162	13	June 27	Sept. 25	5,300	7	Aug. 16	Sept. 25
Alaska Salmon Packing and Fur Co., Loring, Naha Bay	1,800	10,470	11.5	June 25	Sept. 2	2,306	8.5	Aug. 8	Sept. 20
Boston Fishing and Trading Co., Yes or McDonald Bay	800	6,754	9	July 12	Sept. 4	1,644	6	Aug. 16	Sept. 12
Glacier Packing Co., Point Highfield, Wrangell Island	1,500	7,428	9.5	June 25	Aug. 6	8,620	8.8	July 7	Sept. 15
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island.	500	9,520	13	June 26	Aug. 31	1,995	8 to 9	Aug. 18	Sept. 20
Baranoff Packing Co., Redfish Bay, Baranof Island	500	4,058	11	June 27	Aug. 28	1,576	5	Aug. 21	Sept. 14
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet.	1,600	31,241	10.3	June 25	Sept. 13	1,488	7.5	Aug. 29	Sept. 13
Pacific Packing Co., Odiak, Prince William Sound	1,500	13,315	12.7	May 6	Aug. 10				
Pacific Steam Whaling Co., Orca, Prince William Sound	1,500	21,927	9.5	May 13	July 31	3,414	7.5	Aug. 12	Sept. 12
Arctic Fishing Co., Kussilof River, Cook Inlet	1,500	24,701	14.1	May 25	Aug. 12	2,313	12.1	July 20	Aug. 12
Hume-Aleutian Packing Co., Karluk, Kadiak Island	2,600	49,633	11.9	June 16	Sept. 20				
Karluk Packing Co., Karluk, Kadiak Island	2,600	54,777	11.9	June 3	Oct. 9				
Alaska Improvement Co., Karluk, Kadiak Island	1,500	49,852	11.9	June 12	Sept. 21				
Arctic Packing Co., Alitak Bay, Kadiak Island	1,500	37,401	13.7	June 9	Aug. 29				
Pacific Steam Whaling Co., Uyak Anchorage, Kadiak Island.	800	17,000	12	July 3	Sept. 15				
Hume Bros. & Hume, Uyak Anchorage, Kadiak Island	800	13,375	12.7	June 14	Sept. 15				
Uganuk Fishing Station, Uganuk Bay, Kadiak Island	1,400	2,113	10	June 10	July 13				
Chignik Bay Co., Chignik Lagoon, Chignik Bay	2,600	36,834	12.4	June 8	Aug. 27	942	11	Aug. 1	Aug. 27
Hume Bros. & Hume, Anchorage Bay, Chignik Bay	800	12,000	12	June 12	Aug. 12				
Pacific Steam Whaling Co., Anchorage Bay, Chignik Bay	800	23,500	12	June 9	Aug. 15				
Arctic Packing Co., Nushagak River	2,000	}							
Alaska Packing Co., Nushagak River	2,000	}88,791	14	June 23	July 20	10,119		Aug. 1	Aug. 7
Bristol Bay Canning Co., Nushagak River	2,000	}							
Point Roberts Packing Co., Kvichak River, Bering Sea	2,000	55,382	12.4	June 23	July 20				
Arctic Packing Co., Naknek River, Bering Sea	1,800	34,496	12.4						
Naknek Packing Co., Naknek River, Bering Sea	1,500	18,000	12	June 30	Aug. 1				
Ugashik Fishing Station, Ugashik River, Bering Sea	1,800	38,261	12						
		688,581				43,557			

Name of company and location of cannery.	Humpbacks. Number of cases packed.	Humpbacks. Average number per case.	Humpbacks. Commenced packing.	Humpbacks. Finished packing.	King and dog salmon. Number of cases packed.	King and dog salmon. Average number per case.	King and dog salmon. Commenced packing.	King and dog salmon. Finished packing.
Quadra Packing Co., Mink Bay, Boca de Quadra	14,000							
Metlakahtla Industrial Co., Metlakahtla, Annette Island	7,260		July 20	Aug. 26	[1]300		Scattering through season.	
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island.	15,926	19	July 6	Aug. 31				
Alaska Salmon Packing and Fur Co., Loring, Naha Bay	49,264	23	July 9	Aug. 28				
Boston Fishing and Trading Co., Yes or McDonald Bay	12,806	15	July 12	Sept. 6	Dog, 1,096	6	July 17	Aug. 7
Glacier Packing Co., Point Highfield, Wrangell Island	28,624	23.1	July 12	Aug. 18	King, 1,246	3.9	May 15	June 25
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island.	4,190	22	July 26	Aug. 22				
Baranoff Packing Co., Redfish Bay, Baranof Island	8,436	23	July 19	Sept. 1				
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet.					King, 4,727	3.1	May 28	June 28
Pacific Packing Co., Odiak, Prince William Sound	9,784	24.5	July 5	Aug. 8	King, 202	4.8	May 6	June 13
Pacific Steam Whaling Co., Orca, Prince William Sound	3,415	18.7	July 9	Aug. 5				
Arctic Fishing Co., Kussilof River, Cook Inlet					King, 5,518	2.5	May 26	July 27
Chignik Bay Co., Chignik Lagoon, Chignik Bay	[2]383	15	July 31	Aug. 25				
Pacific Steam Whaling Co., Anchorage Bay, Chignik Bay	500	20	July 20	Aug. 15				
Alaska Packing Co., Nushagak River, Bering Sea	3,123		Scattering through season.		King, 5,823	3	June 7	June 23
Point Roberts Packing Co., Kvichak River, Bering Sea					King, 126	2.7	June 7	June 23
Arctic Packing Co., Naknek River, Bering Sea					King, 180			
Ugashik Fishing Station, Ugashik River, Bering Sea					King, 11			
	157,711				[3]19,229			

[1] Do-overs. [2] Humpback and dog salmon. [3] Includes dog salmon.

Table showing the value of plants, the employees, and fishing apparatus of the Alaska salmon canneries for 1896.

Name of company and location of cannery.	Value of plant.	Fishermen.		Other employees.		
		White.	Native.	White.	Native.	Chinese.
Quadra Packing Co., Mink Bay, Boca de Quadra	(?)	....	....	....	....	....
Metlakahtla Industrial Co., Metlakahtla, Port Chester, Annette Island	$23,356	....	72	....	[2] 162	....
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island	40,000	8	45	6	6	58
Alaska Salmon Packing and Fur Co., Loring, Naha Bay	73,000	50	75	6	[3] 15 to 20	130
Boston Fishing and Trading Co., Yes or McDonald Bay	40,000	15	20	3	[3] 10	50
Glacier Packing Co., Point Highfield, Wrangell Island	45,000	20	70	8	[3] 4	80
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island	20,000	2	40	7	[3] 32 [4] 30	2
Baranoff Packing Co., Redfish Bay, Baranof Island	12,000	....	17	3	....	31
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet	[1] 113,000	60	200	14	....	87
Peninsula Trading and Fishing Co., Coquenhena, Copper River Delta	40,000	40	....	20	....	60
Pacific Packing Co., Odiak, Prince William Sound	51,000	64	....	7	....	66
Pacific Steam Whaling Co., Orca, Prince William Sound	60,000	60	....	25	....	65
Arctic Fishing Co., Kussilof River, Cook Inlet	[1] 108,000	35	....	8	20	100
Hume-Aleutian Packing Co., Karluk, Kadiak Island Karluk Packing Co., Karluk, Kadiak Island	[1] 600,000	....	....	[5] 200	[5] 100	200
Alaska Improvement Co., Karluk, Kadiak Island	38,000	60	18	16	....	122
Arctic Packing Co., Alitak Bay, Kadiak Island	[1] 106,000	25	....	7	10	57
Uganuk Fishing Station, Uganuk Bay, Kadiak Island	50,000	20	....	12	16	70
Chignik Bay Co., Chignik Lagoon, Chignik Bay, Alaska Peninsula	[1] 225,000	73	....	[6] 16	33	158
Hume Bros. & Hume, Anchorage Bay, Chignik Bay	30,000	40	....	20	....	90
Pacific Steam Whaling Co., Anchorage Bay, Chignik Bay	40,000	30	....	15	....	58

Name of company.	Gill nets and traps—number, dimensions, and value.	Seines—number, dimensions, and value.
Quadra Packing Co	....	(No data.)
Metlakahtla Industrial Co	....	9 drag seines, 100 fathoms long; $200 each. 2 purse seines, 120 fms. long; $350 each.
Pacific Steam Whaling Co., Hunter Bay.	....	9 drag seines, average 75 fms. long; $1.25 per fm. 1 purse seine, 175 fms. long, 12 fms. deep; $522. 1 purse seine, 175 fms. long, 7 fms. deep; $300.
Alaska Salmon Packing and Fur Co.	....	21 drag seines, 75 to 250 fms. long; $1.50 per fm.
Boston Fishing and Trading Co	....	4 drag seines, 80 to 140 fms., 3-inch mesh; $1.50 per fm. 1 purse seine, 220 fms. by 30 fms., 3-inch mesh; $800.
Glacier Packing Co	14 gill nets, 250 fms., $8\frac{1}{2}$-inch mesh, 24 meshes deep; 40 cents per fm. 14 gill nets, 200 fms., $6\frac{1}{2}$-inch mesh, 26 meshes deep; 40 cents per fm.	9 drag seines, 50 to 150 fms. long by 3 to 8 fms. deep; $1.50 per fm.
North Pacific Trading and Packing Co.	1 experimental trap; $1,000	4 drag seines, 110 fms. long; $1.50 per fm.
Baranoff Packing Co	....	2 drag seines, 125 fms. long; $1.50 per fm.
Pyramid Harbor Packing Co	12 gill nets, 200 fms. by 16 feet, $8\frac{1}{2}$-inch mesh; 65 cents per fm. 46 gill nets, 300 fms. by 10 feet, $6\frac{1}{8}$-inch mesh; 65 cents per fm.	
Peninsula Trading and Fishing Co.	10 gill nets, 100 fms., 24 meshes deep; $1 per fm ... 20 gill nets, 200 fms., 30 meshes deep; $1 per fm ...	
Pacific Packing Co	32 sets gill nets, 450 fms. per set. Mesh, $6\frac{1}{4}$-inch for red; $6\frac{1}{2}$-inch for coho; $9\frac{1}{2}$-inch for king; $1 per fm.	2 drag seines, 150 fms., 3-inch mesh, 120 meshes deep; $1 per fm.
Pacific Steam Whaling Co., Orca	30 sets gill nets, 350 fms. per set. Mesh, $6\frac{1}{4}$-inch for red; $6\frac{1}{2}$-inch for coho; $9\frac{1}{2}$-inch for king; $1 per fm.	3 drag seines, 150 fms. long; $1 per fm.
Arctic Fishing Co	15 gill nets, 50 fms. long, $6\frac{1}{4}$-inch mesh, 30 meshes deep; $1 per fm. 15 gill nets, 50 fms. long, $9\frac{1}{2}$-inch mesh, 22 meshes deep; $1 per fm. 8 traps, 30 to 50 foot pots; 300 to 700 foot leaders; $300 to $1,500 each.	
Hume-Aleutian Packing Co Karluk Packing Co	....	8 drag seines, 450 fms., 3-inch mesh, 145 meshes deep; $1.50 per fm. 2 drag seines, 425 fms., 3-inch mesh, 180 meshes deep; $1.50 per fm. 1 drag seine, 200 fms., 3-inch mesh, 100 meshes deep; $1.50 per fm.
Alaska Improvement Co	1 floating trap at Uganuk; leader 200 fms., pot 36 ft. by 200 ft., $3\frac{1}{4}$-inch mesh; $1,500.	3 drag seines, 500 fms., $3\frac{1}{4}$-inch mesh; $1.75 per fm. 3 drag seines, 375, 175, and 150 fms.; $1.75 per fm.
Arctic Packing Co., Alitak Bay	....	2 drag seines, 250 fms. deep by 120 m., 3-inch mesh; $1 per fm. 2 drag seines, 200 fms. deep by 100 m., 3-inch mesh; $1 per fm. 1 drag seine, 100 fms. deep by 80 m., 3-inch mesh; $1 per fm.
Uganuk Fishing Station	1 trap fence; $800	2 drag seines, 350 fms., 3-inch mesh, 125 meshes deep, $1.50 per fm.
Chignik Bay Co	3 gill nets, 150 fms., $6\frac{1}{4}$-inch mesh; 65 cents per fm. 9 traps, leaders average 1,350 feet; $1,000 each.	5 drag seines, 200 fms. long., 3-inch mesh, 100 meshes deep; $1.50 per fm.
Hume Bros. & Hume, Anchorage Bay.	10 gill nets, 200 fms., $6\frac{1}{4}$-inch mesh, 40 meshes deep; 75 cents per fm. 3 traps, leaders 150 to 200 fms; $1,200 each	1 drag seine, 250 fms. long, 3-inch mesh; $1.50 per fm. 1 drag seine, 200 fms. long, 3-inch mesh; $1.50 per fm. 1 drag seine, 100 fms. long, 3-inch mesh; $1.50 per fm.
Pacific Steam Whaling Co., Anchorage Bay.	5 traps, 150 to 200 fm. leaders; 40-feet square pots: $1,100 each.	2 drag seines, 250 fms. long, 3-inch mesh; $1.50 per fm.

[1] Includes the values of cannery plants in reserve in the district.
[2] During busy season.
[3] Women.
[4] Men and boys.
[5] Includes fishermen.
[6] Includes 3 coal miners.

Table showing the vessels and boats employed by the Alaska salmon canneries in 1896.

Name of company.	Steam vessels.				Sail vessels.				
	Name.	Net tons.	Value.	Crew.	Name.	Rig.	Net tons.	Value.	Crew.
Metlakahtla Industrial Co	Marie G. Haaven	13	$3,000	5	(Transport by regular line of steamers.)				
Pacific Steam Whaling Co., Hunter Bay.	Alice	20	10,000	5	(Transport by calling vessel of company.)				
	Minnie M. (launch)	3	400	2					
Alaska Salmon Packing and Fur Co.	Novelty	34	12,000	5	Electra	Bark	940	$12,000	Fishermen.
	Arctic	21	12,000	5					
Boston Fishing and Trading Co.	Rosie (launch)	5	2,000	2	(Transport by regular line of steamers.)				
	(Chartor extra during busy season.)								
Glacier Packing Co	Ella Rohlffs	37	14,000	5	Geo. Skolfield.	Ship	1,276	16,000	Fishermen.
	Puritan	14	10,500	5					
North Pacific Trading and Packing Co.	Klawack	11	5,000	4	(Transport by chartered vessel.)				
	Cora (launch)		1,000	3					
Baranoff Packing Co	Wigwam	24	10,000	5	(Transport by chartered vessel.)				
Pyramid Harbor Packing Co	Elsie	38	16,000	5	Invincible	Ship	1,394	Chartered	Fishermen.
	Lillian	20	8,800	4					
Peninsula Trading and Fishing Co.	Thlinket (st. wheel)	50	10,000	5	(Transport by vessel from Orca.)				
	Beaver (launch)	5	4,000	3					
Pacific Packing Co	Pacific	32	14,000	6	Gatherer	Bark	1,377	Chartered	
	S. B. Matthews (st. wh.)	165	14,000	6					
	Susanna (stern-wheel)	18	9,000	6					
Pacific Steam Whaling Co., Orca.	Wildcat (stern-wheel)	50	10,000	5	America	Ship	1,909	Chartered	Fishermen.
Arctic Fishing Co	Jennie	70	26,000	7	Prussia	Bark	1,131	Chartered	Fishermen.
	Olga	8	6,000	2					
	Arthur (launch)	5	2,100	2					
Hume-Aleutian Packing Co; Karluk Packing Co	Hattie Gage	42	17,000	8	Santa Clara	Ship	1,473	30,000	18
	2 launches	5 (each)	2,000 (each)	2 (each)	St. Nicholas	Ship	1,688	Chartered	19
Alaska Improvement Co	Kadiak	58	23,000	8	Centennial	Ship	1,139	14,250	14
	Alaska	23	7,500	5	Harvester	Bark	716	7,750	10
	Delphine (Launches)	5	4,500	2	Premier	3-m. sch.	292	9,000	8
	Corinne (Launches)	5	3,750	2					
Arctic Packing Co, Alitak Bay.	Aleut	19	10,000	4	Coryphene	Bark	771	Chartered	
Uganuk Fishing Station	(Station tended by steamer from Karluk.)				(Transport by vessels from Karluk.)				
Chignik Bay Co	Afognak	38	15,750	9	Llewellyn J. Morse.	Ship	1,271	25,000	Fishermen.
	Baby Ruth (st. wheel)	10	4,500	3					
Hume Bros. & Hume, Anchorage Bay.	Florence Hume	8	3,000	2	Leon	Bark		7,000	12
					Equator	Schr	69	6,000	6
Pacific Steam Whaling Co., Anchorage Bay.	Salmo	35	7,000	4	(Transport by calling vessel of company.)				

Name of company.	Lighters, etc.		Boats.	
	Number and description.	Value.	Number and description.	Value.
Metlakahtla Industrial Co	2 lighters	$150 each	7 Columbia-river boats	$180 each.
			10 skiffs	$30 each.
Pacific Steam Whaling Co., Hunter Bay	3 lighters	$100 each	2 whale boats	$85 each.
	2 purse-seine scows	$150 each	5 seine boats	$50 each.
	2 pile drivers	$750 each		
Alaska Salmon Packing and Fur Co	29 lighters and scows	$50 to $100 each.	21 seine boats	$50 each.
Boston Fishing and Trading Co	6 lighters	$50 to $75 each	4 seine boats	$50 to $75 each.
Glacier Packing Co	2 lighters: 1	$50	14 Columbia-river boats	$180 each.
	1	$400	20 dories and skiffs	$25 each.
North Pacific Trading and Packing Co	1 fish scow	$100	4 seine boats	$90 each.
Baranoff Packing Co			4 seine boats	$75 each.
Pyramid Harbor Packing Co	4 lighters	$50 each	48 Columbia-river boats	$200 each.
			Several skiffs	$20 each.
Peninsula Trading and Fishing Co	2 lighters	$200 each	20 Columbia-river boats	$200 each.
Pacific Packing Co	1 lighter	$250	32 Columbia-river boats	$200 each.
			2 seine boats	$100 each.
Pacific Steam Whaling Co., Orca	2 lighters	$250 each	30 Columbia-river boats	$200 each.
			3 seine boats	$100 each.
Arctic Fishing Co	3 sloop lighters	$400 each	15 gill-net boats	$50 each.
	1 coal scow	$500	6 trap scows	$50 each.
	1 pile driver	$750		
Hume-Aleutian Packing Co; Karluk Packing Co	13 lighters	$400 each	15 seine boats	$125 each.
			70 dories	$25 each.
Alaska Improvement Co			7 beach seine boats, 35 feet.	$4 per linear foot.
			2 river seine boats, 25 feet.	$4 per linear foot.
			1 river seine boat, 20 feet	$4 per linear foot.
			Many dories and skiffs	$25 each.
Arctic Packing Co., Alitak Bay	3 lighters	$250 each	4 seine boats	$150 each.
	4 scows	$100 each	10 dories	$20 each.
Uganuk Fishing Station	8 lighters	$200 each	7 scows	$60 each.
			10 dories	$20 each.
Chignik Bay Co	7 lighters	$350 each	12 seine and gill-net boats	$125 each.
	10 trap scows	$200 each		
	2 pile drivers	$650 each		
Hume Bros. & Hume, Anchorage Bay	4 lighters	$350 each	10 gill-net boats	$200 each.
	4 trap scows	$100 each	8 boats and skiffs	$25 each.
	1 sail scow	$500		
Pacific Steam Whaling Co., Anchorage Bay	11 lighters and scows	$50 to $250 each	4 seine boats	$60 each.
	1 pile driver	$650	Several skiffs	$20 each.

Table showing the value of plants, the employees, and fishing apparatus of the Alaska salmon canneries for 1897.

Name of company and location of cannery.	Value of plant.	Fishermen.		Other employees.		
		White.	Native.	White.	Native.	Chinese
Quadra Packing Co., Mink Bay, Boca de Quadra	....	20	20	8	....	50
Metlakahtla Industrial Co., Metlakahtla, Port Chester, Annette Island	$23,356	....	72	....	[1] 162	....
Pacific Steam Whaling Co., Hunter Bay, Prince of Wales Island	40,000	35	45	6	6	58
Alaska Salmon Packing and Fur Co., Loring, Naha Bay	73,000	20	175	7	[2] 25	130
Boston Fishing and Trading Co., Yes or McDonald Bay	40,000	15	20	3	[2] 10	50
Glacier Packing Co., Point Highfield, Wrangell Island	45,000	20	70	8	[2] 4	80
North Pacific Trading and Packing Co., Klawak, Prince of Wales Island	20,000	2	40	8	[3] 62	7
Baranoff Packing Co., Redfish Bay, Baranof Island	12,000	....	17	3	....	31
Pyramid Harbor Packing Co., Pyramid Harbor, Chilkat Inlet	[4] 113,000	60	300	14	....	87
Pacific Packing Co., Odiak, Prince William Sound	51,000	64	....	7	....	66
Pacific Steam Whaling Co., Orca, Prince William Sound	60,000	86	....	17	6	81
Arctic Fishing Co., Kussilof River, Cook Inlet	[4] 108,000	35	....	8	20	100
Hume-Aleutian Packing Co., Karluk, Kadiak Island						
Karluk Packing Co., Karluk, Kadiak Island	[4] 858,507	126	....	[5] 65	25	390
Alaska Improvement Co., Karluk, Kadiak Island						
Uganuk Fishing Station, Uganuk Bay, Kadiak Island	([6])	[6] 20	....	[6] 12	....	[6] 96
Arctic Packing Co., Alitak Bay, Kadiak Island	[4] 106,000	25	....	7	10	57
Pacific Steam Whaling Co., Uyak Anchorage, Kadiak Island	40,000	40	....	20	....	60
Hume Bros. & Hume, Uyak Anchorage, Kadiak Island	30,000	75	....	32	....	69
Chignik Bay Co., Chignik Lagoon, Chignik Bay, Alaska Peninsula	[4] 225,000	57	....	[7] 16	....	103
Hume Bros. & Hume, Anchorage Bay, Chignik Bay	30,000	55	....	10	....	65
Pacific Steam Whaling Co., Anchorage Bay, Chignik Bay	40,000	60	....	15	....	58
Arctic Packing Co., Nushagak River, Bering Sea						
Alaska Packing Co., Nushagak River, Bering Sea	[4] 386,500	144	....	38	40	306
Bristol Bay Canning Co., Nushagak River, Bering Sea						
Point Roberts Packing Co., Kvichak River, Bering Sea	53,000	65	....	10	25	150
Arctic Packing Co., Naknek River, Bering Sea	61,000	45	....	10	10	102
Naknek Packing Co., Naknek River, Bering Sea	....	40	....	10	10	75
Ugashik Fishing Station, Ugashik River, Bering Sea	87,500	59	....	9	24	102

Name of company.	Gill nets and traps—number, dimensions, and value.	Seines—number. dimensions, and value.
Quadra Packing Co., Mink Bay	....	14 drag and purse seines (no data).
Metlakahtla Industrial Co	10 gill nets 180 fathoms long, 4 fms. deep, 5½-inch and 6-inch mesh; $150 each.	9 drag, 100 fms. long; $200 each. 2 purse, 120 fms. long; $350 each.
Pacific Steam Whaling Co., Hunter Bay.	....	12 drag, 75 fms. long; $1.25 per fm. 1 purse, 175 fms. long, 12 fms. deep; $522. 1 purse, 175 fms. long, 7 fms. deep; $300.
Alaska Salmon Packing and Fur Co.	....	21 drag, 75 to 250 fms. long; $1.50 per fm.
Boston Fishing and Trading Co.	....	4 drag, 80 to 140 fms. long, 3-inch mesh; $1.50 per fm. 1 purse, 220 by 30 fms., 3-inch mesh; $800.
Glacier Packing Co	12 gill nets, 250 fms. by 24 m., 8½-in.; 40 cents per fm. 12 gill nets, 200 fms. by 26 m., 6½-in.; 40 cents per fm.	9 drag, 50 to 150 fms. long, 3 to 8 fms. deep; $1.50 per fm.
North Pacific Trading and Packing Co.	1 experimental trap; $1,000	4 drag, 110 fms. long; $1.50 per fm.
Baranoff Packing Co	....	2 drag, 125 fms. long; $1.50 per fm.
Pyramid Harbor Packing Co	12 gill nets, 200 fms. long, 16 feet deep, 8½-inch mesh; 65 cents per fm. 46 gill nets, 300 fms. long, 10 feet deep, 6½-inch mesh; 65 cents per fm.	
Pacific Packing Co	32 gill nets, sets, 450 fms. per set; mesh 6¼-inch, red; 6½-inch, cobo; 9½-inch, king; $1 per fm.	2 drag, 150 fms., 3-inch mesh, 120 m. deep; $1 per fm.
Pacific Steam Whaling Co., Orca	43 gill nets, sets, 450 fms. per set; mesh 6¼-inch, red; 6½-inch, coho; 9½-inch, king; $1 per fm.	4 drag, 150 fms.; $1 per fm.
Arctic Fishing Co	15 gill nets, 50 fms. long, 30 m. deep, 6¼-in.; $1 per fm. 15 gill nets, 50 fms. long, 22 m. deep, 9½-in.; $1 per fm. 8 traps, 30 to 50 foot pots, 300 to 700 foot leaders; $300 to $1,500 each.	
Hume-Aleutian Packing Co Karluk Packing Co Alaska Improvement Co	....	3 drag, 500 fms., 125 m. deep, 3-in. mesh; $1.50 per fm. 8 drag, 450 fms., 145 m. deep, 3-in. mesh; $1.50 per fm. 3 drag, 425 fms., 180 m. deep, 3-in. mesh; $1.50 per fm. 3 drag, 200 fms., 100 m. deep, 3-in. m.; $1.50 per fm.
Uganuk Fishing Station	1 floating trap, 200-fm. lead, 100-fm. wings; $1,500 1 floating trap, 300-fm. lead, 100-fm. wings; $1,500	2 drag, 350 fms. long, 125 m. deep, 3-in. mesh; $1.50 per fm.
Arctic Packing Co., Alitak Bay	....	2 drag, 250 fms. long, 120 m. deep, 3-in. mesh; $1 per fm. 2 drag, 200 fms. long, 100 m. deep, 3-in. mesh; $1 per fm. 1 drag, 100 fms. long, 80 m. deep, 3-in. mesh; $1 per fm.
Pacific Steam Whaling Co., Uyak Anchorage.	....	2 drag, 300 fms. long, 3 inch mesh; $1.50 per fm. 2 drag, 150 fms. long, 3-inch mesh; $1.50 per fm. 2 drag, 100 fms. long, 3-inch mesh; $1.50 per fm. 1 purse, 300 fms. long; $1,000.
Hume Bros. & Hume, Uyak Anchorage.	3 gill nets, 200 fms. long, 30 meshes deep, 6-inch mesh; 65 cents per fm.	6 drag, 200 to 300 fms. long, 100 to 125 m. deep; $1.75 per fm.
Chignik Bay Co	3 gill nets, 150 fms. long, 6¼-in. mesh; 65 cts. per fm. 10 traps, average 1,350 feet long; $1,000 each	5 drag, 200 fms., 100 m. deep, 3-inch mesh; $1.50 per fm.
Hume Bros. & Hume, Anchorage Bay.	10 gill nets, 200 fms. long, 6¼-inch mesh, 40 meshes deep; 75 cents per fm. 5 traps, leaders 150 to 200 fms.; $1,200 each	1 drag, 250 fms. long, 3-inch mesh; $1.50 per fm. 1 drag, 200 fms. long, 3-inch mesh; $1.50 per fm. 1 drag, 100 fms. long, 3-inch mesh; $1.50 per fm.
Pacific Steam Whaling Co., Anchorage Bay.	8 traps, 150 to 200 fm. leaders, 40-foot square pots; $1,100 each.	2 drag, 250 fms. long, 3-inch mesh; $1.50 per fm.
Arctic Pack'g Co., Nushagak R. Alaska Packing Co Bristol Bay Canning Co	60 gill nets, 125 fms. long, 24 m. deep; 75 cts. per fm. 120 gill nets, 75 fms. long, 24 m. deep; 75 cts. per fm. 4 traps; leaders, 300 feet average; $1,000 each.	
Point Roberts Packing Co	25 gill nets, 60 fms. long, 30 m. deep; 75 cts. per fm. 4 traps, leaders 300 feet; $1,000 each.	
Arctic Packing Co., Naknek River.	11 gill nets, 70 fms. long, 24 m. deep; 75 cts. per fm. 34 gill nets, 70 fms. long, 22 m. deep; 75 cts. per fm. 3 traps, leaders 175 feet; $750 each.	
Naknek Packing Co	30 gill nets, 100 fms. long, 20 m. deep; 40 cts. per fm. 1 double trap; $600	2 drag seines, 60 fms. long (to empty trap); $1.25 per fm.
Ugashik Fishing Station	21 gill nets, 75 fms. long, 24 m. deep; 75 cts. per fm. 2 traps, 150 and 250 foot leaders; $600 each.	

[1] During busy time. [2] Women. [3] 32 women, 30 men and boys. [4] Includes values of cannery plants in reserve. [5] Includes 16 hatcherymen. [6] Included in Karluk figures. [7] Includes 3 coal miners.

Table showing the vessels and boats employed by the Alaska salmon canneries in 1897.

Name of company.	Steam vessels.				Sail vessels.				
	Name.	Net tons.	Value.	Crew.	Name.	Rig.	Net Tons.	Value.	Crew.
Quadra Packing Co	Annie M. Nixon	18	$6,000	5	(No data.)				
Metlakahtla Industrial Co.	Herald	19	7,000	5	(Transport by regular line of steamers.)				
	Marie G. Haaven	13	3,000	5					
Pacific Steam Whaling Co., Hunter Bay.	Alice	20	10,000	5	(Transport by calling vessel of company.)				
	Columbia	70	Chart.	9					
	Minnie M. (launch)	3	400	2					
Alaska Salmon Packing and Fur Co.	Novelty	34	12,000	5	Nicholas Thayer (2 trips)	Bark	556	$10,000	Fishermen.
	Arctic	21	12,000	5	Electra	Bark	940	12,000	Fishermen.
Boston Fishing and Trading Co.	Alaska	38	Chart.	5	(Transport by regular line of steamers.)				
	Rosie (launch)	5	2,000	2					
Glacier Packing Co	Puritan	14	10,500	5	Geo. Skolfield	Ship	1,276	16,000	Fishermen.
	Ella Rohlffs	37	14,000	5					
North Pacific Trading and Packing Co.	Klawack	11	5,000	4	(Transport by chartered vessel.)				
	Cora (launch)		1,000	3					
Baranoff Packing Co	Wigwam	24	10,000	5	(Transport by chartered vessel.)				
Pyramid Harbor Packing Co.	Elsie	38	16,000	5	Invincible	Ship	1,394	Chart.	Fishermen.
	Lillian	20	8,800	4					
Pacific Packing Co	Pacific	32	14,000	6	Centennial	Ship	1,139	20,000	Fishermen.
	S. B. Matthews (st. wh.)	165	14,000	6					
	Susanna (stern-wheel)	18	9,000	6					
Pacific Steam Whaling Co., Orca.	Wolcott	199	25,000	9	America	Ship	1,909	Chart.	Fishermen.
	Wildcat (stern-wheel)	50	10,000	5					
	Thlinket (stern-wheel)	50	10,000	5					
Arctic Fishing Co	Jennie	70	26,000	6	Prussia	Bark	1,131	Chart.	Fishermen.
	Olga	8	6,000	2					
	Arthur (launch)	5	2,100	2					
Hume-Aleutian Pkg. Co.; Karluk Packing Co; Alaska Improvement Co	Hattie Gage	42	17,000	8	Santa Clara (2 trips)	Ship	1,473	30,000	18
	Kadiak	58	20,250	8	St. Nicholas	Ship	1,688	Chart.	19
	Aurora (launch)	5	3,700	2	Nicholas Thayer (2 trips to Loring).	Bark	556	10,000	11
	Ida (launch)	5	2,700	2	Merom (1 trip to Naknek)	do	1,159	16,000	15
	Delphine (launch)	5	2,500	2					
	Julia M. (launch)	5	2,000	2					
Uganuk Fishing Station	(Station tended by steamer from Karluk.)				(Transportation by vessels from Karluk.)				
Arctic Packing Co., Alitak Bay.	Aleut	19	10,000	4	Kate Davenport	Bark	1,175	Chart.	Fishermen.
Pacific Steam Whaling Co., Uyak Anchorage.	Golden Gate	50	20,000	5	(Transport by calling vessel of company.)				
	Beaver (launch)	5	4,000	2					
Hume Bros. & Hume, Uyak Anchorage.	Equator	40	10,000	7	Harvester	Bark	716	7,500	12
Chignik Bay Co	Afognak	38	15,750	9	Llewellyn J. Morse	Ship	1,271	25,000	Fishermen.
	Baby Ruth (stern-wheel)	10	4,500	3					
Hume Bros. & Hume, Anchorage Bay.	Florence Hume	8	3,000	2	Ferris S. Thompson	Bark	514	7,500	11
Pacific Steam Whaling Co., Anchorage Bay.	Salmo	35	7,000	4	(Transport by calling vessel of company.)				
Arctic Packing Co., Nushagak River; Alaska Packing Co; Bristol Bay Canning Co.	Polar Bear	29	12,000	5	Sterling	Ship	1,637	30,000	Fishermen.
	Tyone (launch)	5	4,500	2	Eclipse	Ship	1,535	Chart.	Fishermen.
	Amy S. (launch)	5	3,000	2	Willie R. Hume	Barkentine	632	Chart.	Do.
	Corinne (launch)	5	1,500	2					
Point Roberts Pack'g Co	President	238	49,000	8	Bohemia	Ship	1,529	30,000	Do.
	Northern Light (launch)	5	3,000	2	W. W. Case	Bark	556	10,000	Fishermen.
	J. W. Clark (launch)	5	2,000	2					
Arctic Packing Co., Naknek River.	Ralph L. (launch)	5	4,500	2	Merom	Bark	1,159	16,000	Do.
					Prosper	Sch'r.	230	15,000	Do.
Naknek Packing Co	Emelia (launch)	5	1,200	2	B. P. Cheney	Bark	1,200	14,000	Do.
Ugashik Fishing Station	Thistle	55	25,000	6	Coryphene	Bark	771	Chart.	Do.
	Cathie K (launch)	5	2,500	2					

Name of company.	Lighters, etc.		Boats.	
	Number and description.	Value.	Number and description.	Value.
Quadra Packing Co	1 pile driver	$500	12 lighters and boats	$50 each.
Metlakahtla Industrial Co	2 lighters	$150 each	7 Columbia-river boats	$180 each.
			10 skiffs	$30 each.
Pacific Steam Whaling Co., Hunter Bay	3 lighters	$100 each	2 whaleboats	$85 each.
	2 purse-seine scows	$150 each	5 skiffs	$25 each.
	2 pile drivers	$750 each		
Alaska Salmon Packing and Fur Co	29 fish scows	$50 to $100 each	21 seine boats	$50 each.
Boston Fishing and Trading Co	6 lighters	$50 to $75 each	4 seine boats	$50 to 75 each.
Glacier Packing Co	1 large lighter	$400	14 Columbia-river boats	$180 each.
	1 lighter	$50	20 dories and skiffs	$25 each.
North Pacific Trading and Packing Co	1 fish scow	$100	4 seine boats	$90 each.
Baranoff Packing Co			4 seine boats	$75 each.
Pyramid Harbor Packing Co	4 lighters	$50 each	48 Columbia-river boats	$200 each.
			Several skiffs	$20 each.
Pacific Packing Co	1 lighter	$250	32 Columbia-river boats	$200 each.
			2 seine boats	$100 each.
Pacific Steam Whaling Co., Orca	2 lighters	$250 each	43 Columbia-river boats	$200 each.
			3 seine boats	$100 each.
Arctic Fishing Co	3 sloop lighters	$400 each	15 gill-net boats	$50 each.
	1 coal scow	$500	6 trap scows	$50 each.
	1 pile driver	$750		
Hume-Aleutian Packing Co; Karluk Packing Co; Alaska Improvement Co	13 lighters	$400 each	21 seine boats	$125 each.
			113 dories	$25 each.

Table showing the vessels and boats employed by the Alaska salmon canneries in 1897—Continued.

Name of company.	Lighters, etc.		Boats.	
	Number and description.	Value.	Number and description.	Value.
Uganuk Fishing Station	7 scows 8 lighters	$60 each $200 each	10 dories	$20 each.
Arctic Packing Co., Alitak Bay	3 lighters 4 scows	$250 each $100 each	4 seine boats 10 dories	$150 each. $20 each.
Pacific Steam Whaling Co., Uyak Anchorage	2 lighters	$350 each	5 seine boats 15 dories	$100 each. $25 each.
Hume Bros. & Hume, Uyak Anchorage	2 lighters	$350 each	12 seine boats	$100 each.
Chignik Bay Co	8 lighters 10 trap scows 3 pile drivers	$350 each $200 each $650 each	12 seine and gill-net boats	$125 each.
Hume Bros. & Hume, Anchorage Bay	4 lighters 4 trap scows 1 sail scow	$350 each $100 each $500	10 gill-net boats 8 boats and skiffs	$200 each. $25 each.
Pacific Steam Whaling Co., Anchorage Bay	11 lighters and scows 2 pile drivers	$50 to $250 each $650 each	4 seine boats Several skiffs	$60 each. $20 each.
Arctic Packing Co Alaska Packing Co Bristol Bay Canning Co } Nushagak River	(No data)		98 boats and lighters	(?)
Point Roberts Packing Co	(No data)		32 boats, lighters, and scows	(?)
Arctic Packing Co., Naknek River	(No data)		30 boats and lighters	(?)
Naknek Packing Co	1 lighter 6 lighters 1 pile driver	$700 $300 each $300	20 gill-net boats	$90 each.
Ugashik Fishing Station	(No data)		53 boats and lighters	(?)

SALTERY STATISTICS.

The following table shows the extent to which the salting of salmon was carried in Alaska in 1897, and comprises all the data obtainable, except that, in addition to the amounts given, various small establishments in southeast Alaska salted about 500 barrels. Reducing half-barrels to barrels, it will be seen that the total salt-salmon output for Alaska in 1897 was about 15,543 barrels.

Table giving the saltery statistics of Alaska for 1897.

Location.	Salteries.	Redfish (barrels).	Cohoes (barrels).	King (barrels).	Humpback bellies (half bbls.)
Fort Tongass, southeast Alaska	James Turk				50
Mink Arm, Boca de Quadra, southeast Alaska	Clark & Martin		50		700
Ketchikan, Tongass Narrows, southeast Alaska	do		50		800
Ward Cove, Tongass Narrows, southeast Alaska	Natives (Indians)				100
Hunter Bay, Prince of Wales Island, southeast Alaska	Alaska Packers' Association	[1]500			500
Nutqua Inlet, Prince of Wales Island, southeast Alaska	Pacific Steam Whaling Co	None salted; fish used at Pacific Steam Whaling Co.'s cannery.			
Sukkwan, Sukkwan Island, southeast Alaska	Banter & West				300
Kassook, Sukkwan Island, southeast Alaska	Miller & Co		200		700
Karta Bay, Prince of Wales Island, southeast Alaska	Baronovich Bros				41
Thorne Bay, Prince of Wales Island, southeast Alaska	Robert Bell		160		600
Yes (McDonald) Bay, southeast Alaska	Boston Fishing and Trading Co		150		
Whale Passage, Prince of Wales Island, southeast Alaska	Thomas McCauley				1,400
Lake Bay, Prince of Wales Island, southeast Alaska	do	Abandoned; tanks moved to Whale Passage. All fish supplied to Wrangell cannery.			
Salmon Bay, Prince of Wales Island, southeast Alaska	do				
Red Bay, Prince of Wales Island, southeast Alaska	do				
Shipley Bay, Prince of Wales Island, southeast Alaska	Walter Kosmikoff	Salted few for local use; sold fresh.			
Sar-kar, Prince of Wales Island, southeast Alaska	Fred. Brockman				300
Point Barrie, Kupreanof Island, southeast Alaska	Cyrus Orr	Salted few for local use; sold fresh.			
Point Ellis, Kuiu Island, southeast Alaska[1]	Jack Mantle	[2]Salted few for local use; sold fresh.			
Killisnoo, Chatham Strait, southeast Alaska[2]	Alaska Oil and Guano Co	[3]75	80	25	200
Port Althorp, southeast Alaska	Ford & Stokes	Reported abandoned.			
Neva Strait, southeast Alaska	Morrissey & Co	Abandoned.			
Sandy Bay, southeast Alaska	do	Abandoned.			
Tyonek, Cook Inlet	C. D. Ladd	[4]100			
Eagle Harbor, Kadiak Island	Eagle Harbor Packing Co	616			
Alitak Bay, Kadiak Island	Alaska Packers' Association	67			
Nushagak River, Bristol Bay, Bering Sea	do	178		32	
Do	C. E. Whitney & Co	2,436			
Koggiung, Kvichak River, Bristol Bay, Bering Sea	Alaska Packers' Association	1,489		220	
Naknek River, Bristol Bay, Bering Sea	Naknek Packing Co	600			
Egegak River, Bristol Bay, Bering Sea	Alaska Packers' Association	3,574		15	
Ugashik River, Bristol Bay, Bering Sea	do	138			
Do	C. A. Johnson	1,460			
Total		11,158	710	292	5,691

[1] Redfish and coho mixed.
[2] A few half-barrels of redfish.
[3] Half-barrels. 950 half-barrels of herring were also salted.
[4] For local use.

STREAM AT M'DONALD BAY, LOOKING INTO SMALL LAKE.

MOUTH OF STREAM DRAINING LAKE NEAR MINK ARM, BOCA DE QUADRA

SOUTHEAST ALASKA DISTRICT.

EXTENT AND IMPORTANCE OF THE REGION.

This district extends from the southern boundary of Alaska to Cape Spencer. The trend of the mainland from the entrance to Portland Canal to the head of Lynn Canal is in a general northwest and southeast direction. The strip of territory west of the boundary line between Alaska and British Columbia is about 30 miles wide, and consists of irregular mountain masses often rising precipitously from the sea to an elevation of several thousand feet, and sometimes (as a point farther from the coast is reached) attaining an altitude of 9,000 to 10,000 feet. This rugged condition is broken on every hand by deep valleys or gorges through which the glaciers debouch and from which nearly all the streams on the mainland derive their sources. Fringing the mainland are numerous islands, large and small, close to the coast line, conforming to its irregularities, and separated from it and from each other by deep straits and channels. These islands, about 1,100 in number, extend from the coast an average distance of about 75 miles, and along the general contour for about 250 miles. As a rule they are mountainous and heavily wooded with spruce, hemlock, and cedar, forming an almost impenetrable growth. Some are very large, indented with deep bays and sounds, and they in turn are fringed with smaller islands.

Throughout this region numerous streams and streamlets on the islands and the mainland contain one or more species of salmon, but none alone can furnish sufficient salmon to supply a single cannery, and in only a few streams does the redfish, the principal salmon sought, exist in numbers sufficient for commercial purposes. As a result, each cannery is supplied from many streams, some of them, perhaps, 60 to 80 miles from the establishment. Encroachment of one cannery upon the streams claimed by another frequently occurs, and bad feeling, threats of violence, etc., occasionally result.

The largest salmon rivers in southeast Alaska are the Unuk, Stikine, Taku, and Chilkat, to which further reference will be made. These rivers take their source in the interior and drain considerable areas. The other rivers are usually small streams, and the greater number are simply outlets to a lake or system of lakes. These outlets are in some cases only half a mile in length, generally from 2 to 5 miles, and exceptionally 8 to 10 miles.

By reference to Chart A it will be seen that a line drawn through Sumner Straits and extending to the Stikine River forms a natural fishery division for southeast Alaska. South of this line are seven canneries, with an output in 1897 of 220,341 cases, and all the streams from which their supply is obtained except two small streams that furnish less than 5,000 redfish to the cannery at Wrangell. The division north of this line, though comprising a larger territorial area and coast line, has but two canneries, with an output of 51,526 cases in 1897, and if the Chilkat and Chilkoot rivers are excepted, there would not be sufficient redfish taken in all the streams of the upper division to pack 20,000 cases.

Since 1878 the district has packed 23.2 per cent of the total Alaska pack. In 1897 its percentage was 29.9.

BOCA DE QUADRA.

The *Albatross* arrived at Mary Island, southeast Alaska, June 6, and after making such inquiries relating to the salmon and halibut fisheries as seemed pertinent to the subject, went to the Boca de Quadra and anchored off the cannery the following day.

This body of water is a deep fiord making into the mainland in a general northeast direction from Revillagigedo Channel for a distance of 28 miles. Three smaller fiords branch from it to the southward and eastward, viz, Marten Arm, Mink Arm, and Vixen Bay; and extending to the northward are Badger Bay and Weasel Cove. There are no villages or permanent Indian habitations on the Boca de Quadra—a shack here and there affording temporary shelter during the hunting and fishing seasons. About 2 miles below the entrance on the southern side is a small Indian village named after the Cape Fox chief, Kah-Shakes, who lives there.

The shores are rugged and mountainous. A few streams, all of which contain salmón, discharge their waters into the main arm and into the heads of its branches. Only one, however, is known to be a resort of red salmon, though a second redfish stream empties into Kah-Shakes Cove.

One of the first canneries in Alaska was located on the northern shore of the Boca de Quadra, about 8 miles from the entrance. It was built in 1883 by Mr. M. J. Kinney, of Astoria, and was operated under the name of the Cape Fox Packing Company from 1883 to 1886. In the winter of 1886-87 it was sold and moved to a place now called Ketchikan, in Tongass Narrows, and was operated there under the name of the Tongass Packing Company during the seasons of 1887, 1888, and part of 1889. It was burnt in August, 1889, after having packed about 13,000 cases.

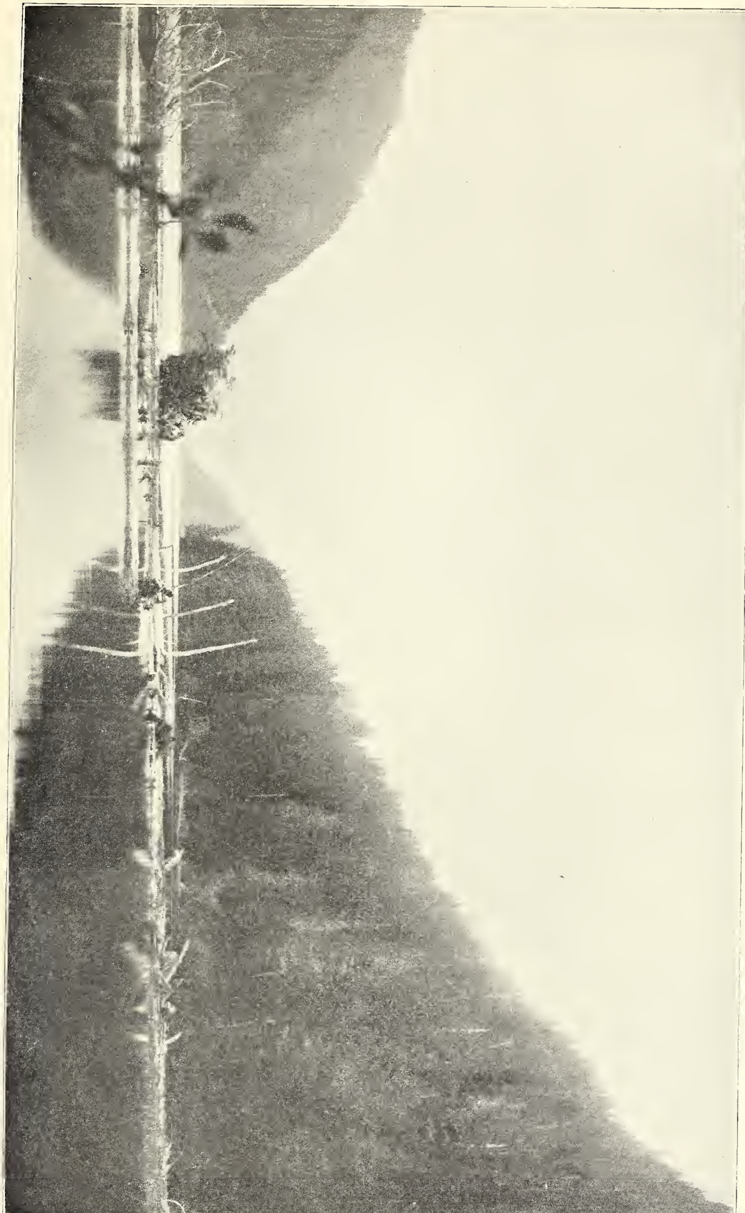
The cannery now operating in the Boca de Quadra was built by the Quadra Packing Company in the spring of 1896, and made its first pack that year. It is on the western shore of Mink Arm, in a small indentation near the entrance, and directly inside of Grouse Island. As the building was only commenced in March, the equipment was necessarily incomplete for the 1896 pack, yet 8,000 cases of redfish were canned. The fish were all taken at no great distance from the cannery, in purse seines. When the *Albatross* was at this point in the early part of the season, new buildings were being erected, the wharf extended, and preparations made for fishing on a more extended scale. For the season of 1897 the steam schooner *Annie M. Nixon* was chartered to transport fish from a distance and as a general cannery tender.

The agent of the company at Victoria reports that the total pack of 1897 was 24,500 cases, of which 7,500 cases were redfish, and the balance humpbacks and cohoes.

QUADRA STREAM AND LAKE.

The mouth of Quadra Stream is N. ½ W., a scant mile from the cannery, in a V-shaped inlet. The entrance is formed by precipitous rocky walls, covered with the dense growth characteristic of this country, and on approaching it the rushing white waters of the rapid stream are seen. The entrance contracts to a width of about 50 yards and then opens into a small bay. This bay receives the water of the stream at low water, but at high tide the fresh water recedes a considerable distance. A saltery was built on the northern shore about seven years ago by Clark & Martin, of Ketchikan. It was not operated in 1896, but some fish were salted in 1897.

After leaving this bay the rapid waters of the stream are encountered, and in less than half a mile the lake which is the source of the stream is found. The stream is



LAKE NEAR BOCA DE QUADRA.

about 20 yards wide, and from the lake to high water has possibly a fall of 30 feet. At the outlet of the lake the stream is heavily choked with drift, but this does not form a serious obstacle to the ingress of salmon.

Quadra Lake is about 4 miles long and from a half to three-fourths of a mile wide, and is surrounded by snow-capped mountains and precipitous shores. The dense, almost impenetrable, forest growth prevents any extended exploration from the shores, and, as the only navigable means at hand was a very crank and leaky canoe, only a cursory examination was made. The lake seems very deep and the water is discolored, probably from decomposed vegetation and the spongy conditions along the shores. It is fed by numerous cascades and falls, formed by the melting snows and the natural drainage, and it is said there is a sandy beach and an entering stream at the head.

It appears, from a superficial examination, that this would afford an excellent site for a hatchery. The small bay at the mouth of the stream could be made into a natural trap, with an abundance of room for all the fish, from which they could be easily removed when wanted, and plenty of water is obtainable by gravity, but it would probably have to be filtered.

Quadra Stream is at present considered one of the best red-salmon streams in southeast Alaska. 97,000 redfish in 1895 were taken from around its mouth and approaches; 137,000 were obtained in 1896, of which number the cannery at Loring secured 44,370 between July 13 and August 31, and Metlakahtla 13,780 from July 14 to August 22; and in 1897 about 65,000 fish were taken, of which 20,000 went to Loring, 4,000 to Metlakahtla, and the remainder to the Quadra cannery. The run of redfish at Quadra for cannery purposes usually lasts from July 15 to September 1. Straggling fish are taken before and after these dates. A few years ago this stream did not rank as a large producer of salmon. Until recently it was tightly barricaded every year. The competition for these salmon has probably caused overfishing by the introduction of more gear than the stream warrants.

In 1897 the locality was fished by the canneries at Loring, Metlakahtla, and Quadra, and the Mink Arm saltery. Fourteen seines, from 200 to 240 fathoms in length, were used, and Clark & Martin, of the saltery, used two purse seines, one 225 fathoms, the other 240 fathoms long. If fishing is continued as extensively as at present, it would seem that a large reduction in the catch must follow.

Judging this stream by others examined, and taking into consideration the probable overfishing, it is thought to have a capacity of 50,000 redfish under average conditions.

The Quadra redfish are the largest found in southeast Alaska, if not in all Alaska. They are well known to all the cannerymen in the vicinity, running 8 to the case, or averaging a trifle over 8 pounds in weight. Early in August they frequently lose their bright and firm appearance, their scales drop off, their fins become frayed, and they commence turning red in color. It is thought by some that these fish have been in fresh water, but such is probably not the case.

During a dry season, such as 1896, the salmon streams of southeast Alaska are so low that the fish can not ascend, but school around the mouths of the streams until the September rains raise the water, when they go up in a body. Fish so held and prevented from running, undoubtedly ripen in the brackish water at the river mouths as the spawning time approaches, and commence to disintegrate just as in fresh water, though not so rapidly.

OTHER STREAMS OF THE BOCA DE QUADRA REGION.

At the head of the main arm of the Boca de Quadra and of the arms making to the southward and eastward are streams having runs of cohoes and humpbacks, but no redfish. The stream at the head of Mink Arm was examined for a distance of about 2 miles. At the mouth it is about 60 feet wide, with an average depth of 6 inches, narrowing to 15 to 20 feet in a short distance. The stream is said to be a lake outlet, the lake lying some distance inland, but no one could be found who has ever visited it.

The stream at the head of Vixen Bay was also examined for a distance of 4 miles. It is from 75 to 100 feet wide at the mouth, narrowing to 50 feet. For the first mile the bottom is gravelly and well adapted for the spawning-grounds of humpback and dog salmon, but for the rest of the distance traveled it contains many bowlders. In the upper part reached by the party it is about 40 feet wide, with an average depth of 10 inches. The current is very strong.

It is said that a large number of cohoes are taken in Marten Arm.

KAH-SHAKES.

The next redfish stream in this vicinity is that which empties into Kah-Shakes Cove. It was unknown to us at the time of our visit to the Boca de Quadra, and therefore not examined. In 1897 there were taken from this stream between 6,000 and 8,000 redfish. From the records of the stream, so far as they are obtainable, it is estimated that under average conditions its annual capacity is 12,000 redfish, and the time of runs is the same as at Quadra, namely, from the middle of July to the last of August. The average weight of these fish is about 7½ pounds.

TONGASS NARROWS—KETCHIKAN.

Ketchikan is situated on the southern side of Revillagigedo Island, about 5 miles from the eastern entrance to the narrows, and is on the Alaska steamer route from Metlakahtla, or Mary Island, to Loring or northern points. The village is on the shore shelf, the houses straggling on both sides of Fish Creek. In 1890 it had a population of 40, of which number 26 were Indians.

The cannery of the Cape Fox Packing Company was moved from the Boca de Quadra to this place in the winter of 1886–87, and operated under the title of the Tongass Packing Company until it was burned. A store, trading post, and a large saltery are owned and maintained by Messrs. Clark & Martin. The senior member of this firm, Mr. George W. Clark, was formerly a Gloucester fisherman, and has been at Ketchikan about ten years, in the trading and fishing business. The saltery at Quadra, previously mentioned, is also owned and operated by this firm.

At the two salteries owned by Clark & Martin 4,000 barrels of salmon were salted in 1894, of which 2,500 were put up at Ketchikan and the remainder at Quadra. The price at that time fell to $4 and $4.50 per barrel, which made salting unprofitable, and these establishments have been operated irregularly since that date until 1897, when a certain number of fish were salted under contract. While the present year has brought a larger price for salt salmon—$8 to $9 per barrel—the firm find it advantageous to sell their fish fresh, under contract, to the canneries. Their salt product is also disposed of by contract.

OUTLET OF LAKE NEAR MINK ARM, BOCA DE QUADRA.

RAPIDS IN STREAM, KETCHIKAN.

FISH CREEK.

Fish Creek, at Ketchikan, is a little larger than the Quadra Stream, and is a lake outlet. It flows with great velocity through a rocky glen, in rapids and falls. There are no artificial obstructions to the passage of fish in this stream. It is a remarkable stream for humpback salmon, containing that species almost exclusively, though a few steelheads find their way to the upper waters. No redfish or cohoes are taken here. The steelheads probably find their way to the lake, but no other species could surmount the falls and rapids. At the time of our visit (June 9) a few steelheads were running upstream, and at one of the rapids an Indian was catching them by means of a large, pointed hook, secured to a stout pole, which he held in the current, and, by sight or touch, hooked the fish broadside on. Mr. Clark stated that steelheads seem more plentiful from the middle of May to the last of June, though he has seen some as early as the middle of April. They are so few in number that they are used for local consumption only.

The run of the humpbacks is from July 15 to September 1. They spawn in the lower courses of the stream in pools and eddies. At low water at the mouth of the river, and facing Tongass Narrows, there is a good seining beach, and it is here that the humpbacks are taken. Their average weight is 4 pounds.

In 1897 Clark & Martin used in their fisheries 1 drag seine at Ketchikan and 1 at George Inlet, each 150 fathoms long, $2\frac{3}{4}$ and 3 inch mesh, valued at \$175 each; 2 purse seines at Quadra, 225 and 240 fathoms long, valued at \$600 each. From 4 to 10 boats were used, and 10 whites and 30 natives were employed. At Fish Creek in 1894 500,000 humpbacks were taken; 246,000 in 1895; 300,000 in 1896, and 500,000 in 1897. In 1897 the run of humpbacks was almost unprecedented. At one haul of a seine 22,000 were taken.

The price paid by the canneries to Clark & Martin for fresh fish, delivered alongside the cannery steamer at the fisheries, was 75 cents per 100 for humpbacks, and \$6.50 per 100 for redfish. If there was any call for dog salmon they received \$3 per 100 for them, but very few of this species are packed.

In 1896 Clark & Martin delivered to Loring cannery 248,258 humpbacks between July 24 and August 31, and in 1897, 318,000 humpbacks from Fish Creek, and 162,000 humpbacks and 20,000 redfish from Quadra. In 1897 they salted, from Fish Creek, 500 half-barrels of humpback bellies; from Quadra, 700 half-barrels of humpback bellies; from George Inlet, 300 half-barrels of humpback bellies, and from scattering places, though mostly from George Inlet, 120 whole barrels of cohoes.

WARD COVE.

About 5 miles to the westward of Ketchikan a small bay known as Ward Cove makes in off Tongass Narrows on the northern shore. A small stream empties into this cove, carrying annually about 2,000 redfish with some other salmon. There was formerly a saltery here, which was purchased by the Alaska Packers' Association and partially dismantled. Some of the buildings are still standing, and an Indian who makes his home in the cove salts a few fish.

The cannery at Loring obtained from Ward Cove in 1897, between July 24 and August 13, 1,500 redfish, 600 cohoes, and 11,000 humpbacks. The stream was not examined.

METLAKAHTLA.

Metlakahtla, or New Metlakahtla, is situated on Port Chester, on the western side of Annette Island. It consists of a community of Tsimpsean Indians who, in 1887, followed Mr. William Duncan from Metlakahtla, British Columbia, to make a home in Alaska. So much has been written of this interesting colony that a history of their progress is superfluous in this report. Suffice it to say, that all honor is due to the energetic and intelligent civilizer and preacher, Mr. Duncan. In 1856 he found the Tsimpseans hardened savages and cannibalistic in their tendencies, and was obliged to live inside a stockade for protection. After having brought them to a civilized condition through his own example and energetic teachings, some question arose in the church, and he deemed it best to retire. He was followed by about 400 of the community, and, as they were not allowed to carry with them their own belongings, they calmly faced the privations they were to endure in their new home, and to-day the New Metlakahtla stands a monument to their skill and industry and an honor to the self-sacrificing devotion of their leader.

Annette Island has been set aside by an act of Congress for a reservation for the Metlakahtlans and other Alaskan natives who may join them, under regulations prescribed by the Secretary of the Interior. An attempt has been made by some influential whites to open mines on the island. In 1890 the population of Metlakahtla was 823, of which number 817 were Indians, 4 whites, and 2 mixed.

One of the principal industries of this community is salmon canning, which is carried on by an organization known as the Metlakahtla Industrial Company. When the colony moved to their new home in 1887, after the people were comfortably housed, Mr. Duncan commenced erecting buildings with a view to establishing a cannery. It took several years to obtain the necessary funds and install the machinery, and it was not until 1890 that any pack was attempted. In that year an experimental pack of only 500 cases was made. The following year it was in active operation and a pack of 5,834 cases was the result.

All parts and branches of the cannery and the fisheries supplying it are conducted by native Indians, who show considerable skill in the different kinds of work. During the time of our first visit, June 10 to 12, they were making cans for the season's pack, rebuilding the steam tender, and some 30 or 40 women and girls were making seines and nets for the use of the community and for sale. All this work is done by the Indians, and apparently well done.

The value of the cannery buildings, machinery, piping, tools, material, etc., is a little under $25,000. In 1896 the product of 72 native fishermen was used, and during August 162 natives were employed in the cannery. In the fisheries they used 9 drag seines, each 100 fathoms in length, valued at $200 each; and 2 purse seines, 120 fathoms long, worth $350 each. The vessels and boats employed were the steam tender *Marie G. Haaven* (rebuilt in the spring of 1897), valued at $3,000, of 12.8 net tons, and with a crew of 5; also 7 Columbia River boats, valued at $180 each; 2 lighters at $150 each, and 10 skiffs, etc., at $30 each.

The statistics for 1897 were about the same as for 1896, but besides the seines, 10 gill nets were tried, 180 fathoms long, 4 fathoms deep, 5½-inch and 6-inch mesh, and valued at $150 each; and in addition to the *Marie G. Haaven*, another steamer, the *Herald*, was purchased. This was of 19.4 net tons burden, had a crew of 5, and was valued at $7,000.

SALMON CANNERY, METLAKAHTLA.

STREAM AT NICHOLS BAY.

The following table shows the packs at Metlakahtla for 1896 and 1897:

Species.	1896.				1897.	
	No. of cases.	Number of fish per case.	Value per case.	Date of packing.	No. of cases.	Date of packing.
Redfish	8,280	*12	$3.80	July 1 to Sept. 5	7,090	July 8 to Sept. 2.
Cohoes	1,500	6 or 7	3.40	Aug. 1 to Sept. 10	840	July 20 to Sept. 2.
Humpbacks	7,420	21 or 22	2.40	July 21 to Aug. 22	7,260	July 20 to Aug. 26.
Do-overs	450		3.00	July 1 to Sept. 10	300	
Total	17,650				15,490	

* Quadra redfish ran 8 to the case; those from Moira Sound, 15 to the case. The average was about 12.

The gill nets were not very successful, the failure being attributed to a too large mesh. Mr. Duncan thinks that 5 and 5½ inch mesh might have done better work. Gill nets have been tried all over Alaska and are now used with success only where the water is discolored; if the water is clear the fish see the net and the catch is small. In some places, where the waters are discolored, gill nets only are used. Of these places, there may be mentioned the mouths and approaches of the Unuk, Stikine, Taku, and Chilkat rivers in southeast Alaska, Copper River, Cook Inlet, and the Bering Sea district. Fish can be taken in gill nets in other places, but where the water is clear other fishing methods are far more successful.

The Metlakahtla cannery pays for redfish, according to locality, from $5.50 to $7 per 100; for cohoes, from $10 to $14 per 100, and for humpbacks, $1.50 per 100. These prices are unusually high. The redfish is, of course, the species most sought for, but as the canneries increase in number and the output becomes larger, more humpbacks and cohoes are packed to fill up the cannery quota.

The home stream at Metlakahtla lies about 2 miles north of the anchorage, inside of Copper Point. It is about 1¼ miles long, 90 feet wide, and 12 to 15 inches deep, and flows in numerous rapids of easy ascent from the lake of which it is the outlet. The lake is about 3 miles long, half a mile wide, and has connected with it other smaller lakes, but does not appear to have any inflowing stream, being fed by falls and cascades. The banks of both stream and lake are wooded. The outlet is very rocky, and the lake is deep without much shelving; from report it has no extensive spawning-ground.

The average number of redfish taken per year from around the mouth of this stream, for six years, was 8,000; the average time of the catches, from July 8 to August 11; average weight, from 3½ to 4 pounds. A few hundred cohoes are taken from July 22 to September 1.

Off the mouth of the river, and well out in the bay, there seems to be a schooling-ground for humpbacks, of which the average catch for four years was 38,000 per year, the run extending from July 27 to August 30. A considerable number are furnished for local use.

On the eastern side of Annette Island, and opposite Mary Island, is another schooling-ground for humpbacks. In 1893 the Metlakahtla fishermen took from this locality, between August 1 and 26, 140,000 humpbacks; in 1896, between August 3 and 22, 68,000; and in 1897, between July 27 and August 7, 29,000.

The cannery at Metlakahtla has received redfish from Quadra and Kah-Shakes also, though the latter stream furnished none here in 1896 and 1897.

GEORGE AND CARROLL INLETS—THORNE ARM—DUKE ISLAND.

From George Inlet about 3,000 redfish, of an average weight of 5 pounds, and occasionally a few cohoes and humpbacks, are obtained. The redfish are taken from July 1 to August 1, the cohoes from the middle of July to the middle of August, and the humpbacks from July 20 to August 15. In 1897 none were received. The exact location of the redfish stream was not ascertained, and it is generally said that only cohoes and humpbacks are found in George and Carroll inlets and in Thorne Arm.

From Duke Island the Metlakahtla cannery receives about 3,000 redfish, of an average weight of 5 pounds; the earliest date given was July 7 and the latest August 28. The streams furnishing these fish empty into the coves at Bay Anchorage, on the eastern side of the island. There are a great number of these small streams throughout Alaska capable of supplying 2,000 to 4,000 redfish, but as a rule the canneries do not bother with them. Under favorable conditions the natives deliver the fish to the canneries or to the tenders in passing.

TAMGASS HARBOR.

Tamgass Harbor supplies an average of 9,000 redfish between July 2 and August 12, though they have been taken as early as June 28 and as late as August 26. These redfish run small, the weight being between 3½ and 4 pounds. A few humpbacks (20,000 in 1897) have also been taken from this locality as early as July 17 and as late as August 26. The stream supplying these fish is on the eastern side of Tamgass Harbor, Annette Island.

The other streams supplying fish to the Metlakahtla cannery are on the eastern side of Prince of Wales Island, in Moira Sound and vicinity, and will be referred to hereafter.

HUNTER BAY.

Hunter Bay is an arm of Cordova Bay, on the western shore of Prince of Wales Island, about 10 miles north of Point Marsh. It is about 2½ miles long and from ⅜ to ⅝ mile wide, with a branch, about midway, extending to the northward. This bay, with the surrounding waters of Cordova Bay, on which, with its branches, are located the salmon streams fished by the Hunter Bay cannery from Point Marsh northward, is unsurveyed.

The cannery operated by the Pacific Steam Whaling Company is on the northern shore of the bay, about 1½ miles from the entrance and about ¾ mile from the head, which receives a redfish stream. The building was commenced in March, 1896, and a sufficient plant was in position to make a pack that year of 27,442 cases. A saltery formerly owned and operated on this site by Miller & Co. was purchased by the Pacific Steam Whaling Company, and removed to make room for the cannery. The main building, like all those of the Pacific Steam Whaling Company, is 270 feet long, double-boarded, painted brown, and is roomy, well ventilated and lighted, in striking contrast with many of the other canneries.

In 1896 the company employed 8 white and 45 Indian fishermen, and in the cannery 6 whites, 6 natives, and 58 Chinese. They used 9 drag seines, average length 75 fathoms, valued at $1.25 per fathom; 1 purse seine, 175 fathoms long by 12 fathoms deep, valued at $522, and another, 175 fathoms long by 7 fathoms deep, valued at $300.

The tenders used were the tug *Alice*, of 20 tons net, crew 5, value $10,000, and a small decked launch, the *Minnie M.*, of 3 tons, crew 2, and valued at $400. There were also employed 3 lighters, valued at $100 each; 5 seine skiffs, $50 each; 2 whaleboats, $85 each; 2 trap drivers, $750 each, and 2 purse-seine scows, $150 each.

SALMON STREAM, EAST SIDE, PORT CHESTER.

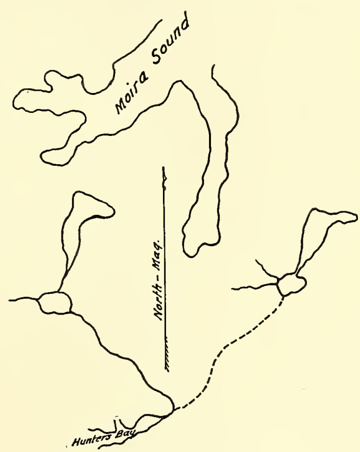
SALMON CANNERY, HUNTER BAY

The cannery equipment in 1897 was the same as for 1896, except that, in addition, the steamer *Columbia*, 70 tons net, crew 9, was chartered, and 3 seines, 3 seine boats, and 27 fishermen were employed.

The following statement gives the pack of Hunter Bay cannery for 1896 and 1897:

Species.	1896.				1897.		
	Dates.	Number of fish per case.	Number of cases.	Approximate number of fish used.	Dates.	Number of fish per case.	Number of cases.
Redfish	July 10 to Sept. 20	10.3	15,386	159,130	June 27 to Sept. 25	13	13,162
Cohoes	Aug. 1 to Sept. 26	7	5,654	39,583	Aug. 16 to Sept. 25	7	5,300
Humpbacks	July 21 to Aug. 29	19	6,402	121,641	July 6 to Aug. 31	19	15,926

In 1896 all the streams from Nichols Bay on the south to Hetta on the north, and including Dall Harbor and Essawa, on Dall Island, were fished to supply this cannery. We visited all the streams in the district except those on Dall Island, which furnished only 3,600 redfish. As the cannery had been operated only one year at the time of our visit, there were no earlier stream records available from which averages or general deductions could be made.



Sketch of Hunter Bay Lake System.

Hunter Bay stream, which empties into the head of the bay about three-fourths of a mile from the cannery, is of considerable size. About one-fourth of a mile above the cannery the bay narrows and shoals to the head, which is bordered by grassy plateaus, forming the banks around the mouth of the stream. It is a beautiful stream and runs over a bouldery bed, between rocky banks covered with a dense forest growth, for a distance of 4½ miles from its lake source to the sea, in a general southeast and northwest direction. It is from 100 to 120 feet wide and a foot deep. There are no obstructions here now, and the flow of water, while rapid, is not much broken and affords an easy ascent for the fish.

The lake is about three-fourths of a mile long by half a mile wide, is deep, and has a large inflowing stream near the upper or northern end, which is connected with a second long L-shaped lake on the northern side. The banks are heavily wooded. There were no means for examining the lake beyond the outlet, and the information in regard to the second lake and the entering stream is from local authorities. Judging from the flow at the outlet, the lake must receive a large amount of water.

Mr. Miller states that this stream should yield 50,000 redfish; but in 1896 the cannery obtained, from July 10 to 31, only 5,318 redfish and 4,937 humpbacks; during August 2,300 redfish, 80,845 humpbacks, and 4,836 cohoes; in September, up to the 20th, 8,645 cohoes—a total of 7,618 redfish, 85,782 humpbacks, and 13,481 cohoes.

The catch in 1897 was: From July 6 to September 26, 3,848 redfish; from July 24 to August 20, 44,501 cohoes.

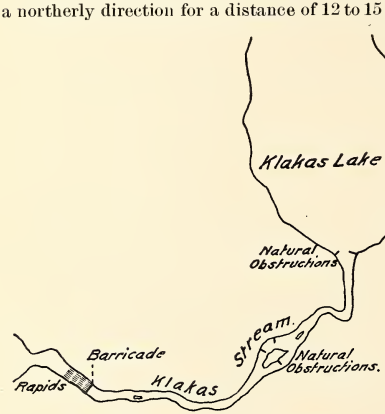
It was not learned whether the stream has ever been barricaded.

The Hunter Bay stream and the one at Nichols Bay would no doubt afford good sites for hatcheries, though careful examination is necessary to determine a point of this kind. There is an abundance of water (which would probably have to be filtered), and an excellent place at each stream could be arranged to hold the fish till ripe. Usually the lake waters undergo a considerable change in temperature during the summer, while the entering streams remain constant and low. Yet these entering streams can not always be utilized, because they are inaccessible and may not afford the abundance of fish which the mouth of the outlet does. The cannery company at Hunter Bay is considering the establishment of a hatchery, which will probably prove successful. With so many excellent sites for hatcheries, the first requisite in this country is accessibility; the second is plenty of fish of a large variety. Water can be obtained anywhere.

Above the cannery, where the bay narrows and shoals toward the head, a trap was driven during our visit. Below the cannery an arm makes to the northward from the bay. At the end of this arm is a narrow passage, or "skookum chuck," as it is called in this country, leading into a bay which receives a small stream carrying a few redfish; it was barricaded. About a mile beyond, on the northern side, is another lagoon making in from the bay, with the entrance obstructed by three islands. This was also examined, but no salmon stream of value was found.

KLAKAS INLET AND STREAM.

Near the entrance to Hunter Bay a long, deep bay called Klakas Inlet makes in a northerly direction for a distance of 12 to 15 miles. It is a beautiful sheet of water, with an average width of about $1\frac{1}{4}$ miles. At the entrance, which is obstructed by islands and reefs, and on the end of the peninsula formed by Klakas Inlet and Hunter Bay, is the Haida village of Klinkwan, one of the older native settlements, and not yet under missionary influence. It contains a large number of carved poles, other totemic symbols, and a few of the old Indian community lodges with interior decorations.



Sketch of Klakas Stream and Lake.

There is one red-salmon stream in Klakas Inlet, on the eastern shore, about 10 miles from Klinkwan. It is the outlet of a lake, and is about a mile long, from 20 to 30 feet wide, and 10 inches deep, with pools under 6 feet in depth. The water in this, as in all these lake outlets, is of a brownish tinge, probably from decomposed vegetable matter. At the head of tide water in the stream is a rapid,

LAKE AT NICHOLS BAY. LOOKING UP LAKE FROM NEAR OUTLET.

which in a distance of 100 yards has a fall of about 20 feet. At this point a barricade of a form similar to those described has been built entirely across the stream, thus effectually preventing fish from ascending.

The lake is 3 to 3½ miles long by ¾ mile wide. The waters seem deep and the shores are high and heavily wooded. There were no means for making a detailed examination of it. The outlet at the lake is about 30 feet wide and 2 feet deep; the current is strong. The banks are high, rocky, and heavily wooded. Besides the barricade, there are a number of log jams, through which fish may, however, find a passage.

The Hunter Bay cannery obtained fish from Klakas in 1896 as follows: From the 1st of July to the 31st, 3,932 redfish and 1,269 humpbacks; during August, 3,382 redfish, 31,200 humpbacks, and 417 cohoes; in September, up to the 20th, 2,240 cohoes; a total of 7,314 redfish, 32,469 humpbacks, and 2,657 cohoes.

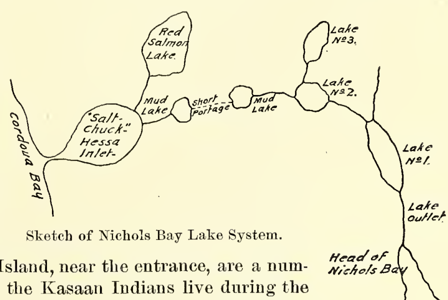
In 1897 the following were taken: Redfish, 23,330, from July 4 to September 26; humpbacks, 108,031, from July 23 to August 31.

The Klawak cannery (hereafter referred to) in 1887 took from Klakas 6,960 redfish between July 3 and September 13, and 2,370 from July 11 to 31, 1888. These are all the records obtainable. The stream is thought to have a capacity for 7,000 redfish.

Between Klinkwan and Klakas are several small streams that contain a few cohoes and humpbacks.

NICHOLS BAY AND TRIBUTARIES.

This bay is on the southern extremity of Prince of Wales Island, with its entrance between Cape Chacon and Point Nunez. At the head of the bay a lake outlet discharges its waters, carrying red salmon (which are considered nearly equal in size to the Quadra fish) and cohoes. In a bight on the southern shore are the remains of an abandoned saltery established and operated by Mr. Miller, of Klinkwan, about 1889, and sold to the Pacific Steam Whaling Company. On the northern shore, and opposite the abandoned saltery, is a stream with a large flow, which has runs of humpback and dog salmon only; at its mouth, on the right bank, are several shacks and a smokehouse. No white people live in this vicinity. On Bean Island, near the entrance, are a number of shacks in which some of the Kasaan Indians live during the halibut-fishing season. The chief of the Kasaans, Skowl, was at Nichols Bay at the time of our visit, and came on board with some of his followers. The only stream of value in this vicinity is the one emptying into the head of the bay. This stream is said to have been barricaded for six or eight years, and in examining it, at a short distance from its mouth a barricade was found which extended entirely across the stream. The day after the examination, men were sent from the *Albatross* with blocks and tackles to pull out the barricade. The rails were removed, but they could not budge the beam. As salmon inspectors are expressly provided for the execution of the law, and as nothing short of dynamite would effectually remove the obstruction, the work was abandoned.



Sketch of Nichols Bay Lake System.

Nichols Bay stream at the barricade (head of tide water) is about 60 feet wide, at the lake outlet about 150 feet, and was at the time of our visit about 12 inches deep. The

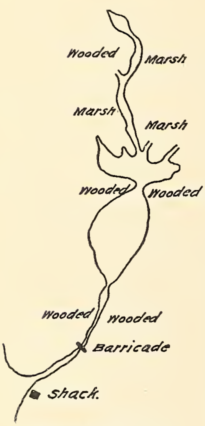
flow is quite rapid, with no natural obstructions to the passage of fish. The distance from the lake to the mouth is about a mile, and the stream flows over a rocky, bowldery bed. The banks are densely wooded, and the mountains abut close on either side, rendering a passage along them almost impracticable. Redfish and cohoes formerly ran here in large numbers.

There were no means of exploring the lake, the banks of which were impassable. So far as could be judged, it is about 2 miles long and one-fourth of a mile wide. The banks are not very high, and there seems to be a shore shelf before the rise to the higher mountains. It was learned that Nichols Bay Lake has a large inflowing stream near its head, and near the mouth of this stream is a smaller one, connecting the first lake with a second or smaller one. This second lake has an entering stream, the connection with a third lake, and another stream connecting it (the second lake) with a fourth. The fourth lake is shallow, with pond lilies growing over it, and from its head there is a portage to a mud lake which has an outlet into the salt chuck at Hessa, on the western side of the island, about 5 miles to the northward of Point Marsh. Into this salt chuck another stream empties, also a lake outlet, which carries salmon and which will be referred to later.

The following table shows the catch from Nichols Bay stream in 1896 and 1897:

Species.	1896.		1897.	
	Dates.	Number of fish.	Dates.	Number of fish.
Redfish	July 10 to Aug. 31	31,192	July 6 to Aug. 31	11,218
Cohoes	Sept. 1 to Sept. 20	550	Aug. 16 to 31	1,313
Humpbacks			July 24 to Aug. 20	54,772

HESSA INLET.

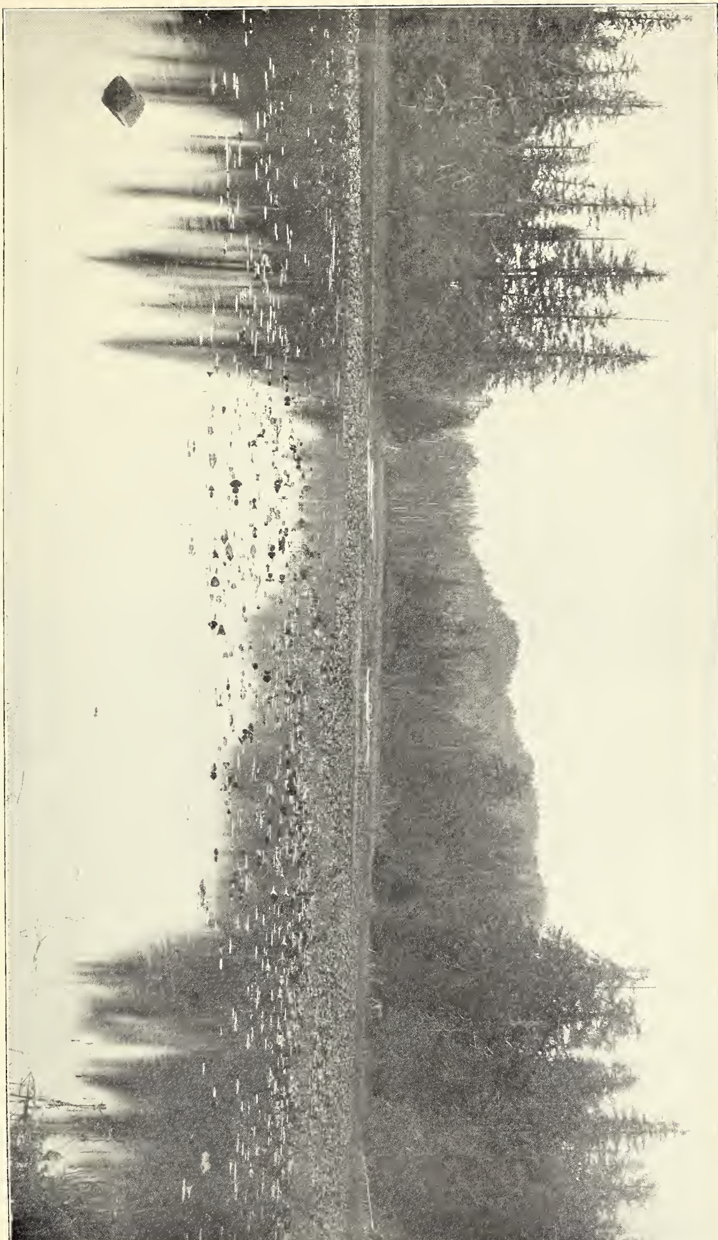


Hessa Lake and Outlet.

Hessa Inlet is about 7 miles southeast from Hunter Bay, and is a large landlocked bay or inlet, about 3 miles long, approached by an entrance scarcely 100 yards wide, through which the tidal current rushes with such velocity that it can only be navigated near or at slack water. At the northern end of the bay is a fisherman's shack, and near it enters a small stream, the outlet to a shallow lake. This outlet is about half a mile long, 25 feet wide, and was about 8 inches deep at the time of examination; it rises to the lake, about 10 feet above high water.

The lake is of irregular outline and about 1 mile long, ramifying in various directions; it is shallow, with a rocky bottom partly covered with gravel or mud. This body of water is in many places surrounded by grassy and marshy banks. In the outlet, at the head of tide water, is a barricade across the full width of the stream built in the usual manner, but with the addition of 2-inch-mesh wire netting, the whole forming such an effectual obstruction that not a single fish can pass upstream. A tree partly felled and ready to fall across the stream is on the right bank.

The cannery record gives no catch of salmon from Hessa in 1896 except 5,215 cohoes, taken in August and up to September 20, though the superintendent stated



LAKE AT HESSA. VIEW FROM NEAR OUTLET, LOOKING TOWARD HEAD.

(OUTLET OF LAKE AT HESSA.

that about 2,000 redfish were also taken. Mr. Miller states that Hessa formerly yielded about 12,000 redfish, but probably it would not yield that number now.

The fishing for the cannery during 1896 was all done by its own men. The tender called at several of the small fisheries to make a single load, and when the fish were discharged they were all entered as coming from one place, the cannerymen not being interested in exact records.

Below Hunter Bay is a small stream, called Tar, from which less than 1,000 cohoes are taken.

NUTQUA INLET.

This is a wide, deep indentation, which makes into Prince of Wales Island, about 15 miles north and west of Klinkwan. At the upper end of the bay, on the eastern side, are a saltery, a dwelling, and some shacks formerly owned by Mr. Miller, but which were sold to the Pacific Steam Whaling Company. At the head of the bay, about 1½ miles from the saltery, is a narrow bowldery passage, less than a mile in length, which leads to a brackish lagoon. The level of this lagoon is a few feet below high water, so the passage is a "skookum chuck," through which the water runs in whirls and rapids almost constantly and with great velocity. The lagoon, or brackish lake, is 5 or 6 miles long by ½ mile wide, and has at its head the mouth of an outlet to a lake, which is said to be several miles distant. This outlet, it is reported, runs over a sandy and gravelly bed. During the visit of the party it was impossible to take the launch through the rapids into the lagoon, and a specific examination could not be made during the limited time at our disposal.

In 1896 the Hunter Bay cannery obtained from this place the following: During August, 150 redfish, 500 humpbacks, and 1,860 cohoes; during September, up to the 20th, 700 redfish and 7,812 cohoes; a total of 850 redfish, 500 humpbacks, and 9,442 cohoes.

In 1897, 8,086 cohoes were taken from August 26 to September 26. This probably does not represent the value of the locality, as it was not fished constantly during either season. It is essentially a coho stream, though the other species also occur.

The saltery was erected in 1895. It is about 80 feet long by 30 wide and is valued at $600; there are also 14 tanks worth $20 each, and some shacks valued at $200. The barrels used are manufactured on the place. No bellies are salted. In 1896 there were very few fish of any kind salted, and in 1897 none were salted. For saltery purposes the fishery has a capacity of 400 barrels a year.

HETTA INLET.

Hetta Inlet is the next to the northward of Nutqua, parallel to it, and separated from it by the long, narrow peninsula which terminates in Lime Point. About 6 miles from the latter point, and nearly midway up the inlet an indentation or bay on the eastern shore receives at its head the outlet from Hetta Lake. There is a shack at the mouth of the outlet, a house near by, and on the southern side of the bay a new house for the fishing crews of the Klawak cannery is located. The outlet runs east-northeast and west-southwest; it is only about one-fourth of a mile long from high-water mark to lake, and about 30 to 50 feet wide at low water, with an average depth of 8 inches. The bottom is rocky and the banks heavily wooded, as, in fact, is all of this country. There are several natural obstructions across the stream which could readily be utilized as barricades. There are no barricades in the stream now, though it is said that until a few years ago it was barricaded every year.

The lake is about 10 feet above high water, and is $1\frac{1}{2}$ miles long. Its lower part is circular and 1 mile in width, the upper part $\frac{3}{4}$ mile in width, and all apparently deep. The general direction is north by east and south by west. A low point juts into the lake on the northwest side. At the upper end the shore is low, heavily timbered, with some grassy spots, and with gravel and sand in places along the shore margin. On all other sides the mountains, from which a number of cascades enter, are precipitous to the lake. A stream 10 feet wide, with an average depth of 4 inches, enters at the upper end. It runs through bottom land over a sandy and gravelly floor, and has a number of pools. The outlet at the lake end is covered with driftwood, which, however, does not prevent the passage of fish.

If Hetta stream has not received some accessions from other localities, it is probably being overfished. It may be classed now as being able to yield 150,000 redfish, though under average conditions 50,000 seems to be the limit. Fish have been taken as early as June 27 (1897) and as late as September 26 (1897). During September, 1896, up to the 20th, 40,529 redfish were taken by the Hunter Bay cannery, and were said to be in good condition. This late catch is attributed, however, to the dry season and the extreme low water in the stream, which prevented them from ascending until after the September rains had raised the water, the result being that fish were held at the mouth and taken when desired. The September catch for 1897 could not be obtained.

Hetta is one of the first-class red-salmon streams in southeast Alaska, and ranks with Quadra and Nichols Bay. It has been fished by the Klawak cannery since 1886, and, with their home stream, has been the main source of fish supply for that cannery. When fishing for this cannery commenced here the rights of the Indian claiming the stream were recognized and a 20-year lease was made with him at an annual rental. In 1896, when the Hunter Bay cannery came into the field, it is said the owners declined to make any agreement in regard to this fishery, and the Klawak cannery at present pays no rental. Hetta is now fished by both canneries, and it is reported that this year there was some trouble between the different fishing parties. This is mentioned simply to show how complaints arise, first on the part of the Indians and then on the part of the canneries. It usually results in the survival of the most powerful corporation, and the Indian goes to the wall.

The following statistics show the Hetta stream catch since 1886:

Year.	Klawak cannery.			Hunter Bay cannery.		
	Species.	Dates.	No.	Dates.	Species.	No.
1887	Redfish	July 3 to Sept. 14	24,022			
1888	do	July 4 to Aug. 26	47,468			
1889	do	July 6 to Aug. 28	48,585			
1890	do	July 6 to Aug. 28	59,673			
1891	do	July 11 to July 16	1,089			
1892	do	July 16 to Aug. 22	51,479			
1893	do	July 11 to Aug. 23	10,586			
1894	do	July 7 to Aug. 31	47,769			
1895	do	July 3 to Aug. 24	78,464			
1896	do	June 29 to Aug. 23	104,602	July 10 to Sept. 20	Redfish	96,697
1897	do	July 7 to Aug. 30	84,980	June 27 to Sept. 26	do	114,796
1897	do			Aug. 22 to Sept. 26	Cohoes	12,964
1897	do			July 20 to Aug. 31	Humpbacks	28,196

The increase in the catch for the last three years is remarkable. In 1895 it was nearly double the average of previous years. In 1896 and 1897 it was five times that average, and it must be remembered that in 1895 the stream was only fished for Klawak cannery. It might be inferred that the increase was due to the two fishing

OUTLET OF HETTA LAKE, FROM ABOVE.

gangs, and therefore to overfishing, but the statement is made that there is a marked increase of fish in these waters, and that other streams in this vicinity have felt it. When questioned as to the probable cause, the fishermen claim that these streams are receiving the adult fish produced by Mr. Callbreath's hatchery on Etolin Island, which was built and began operating in 1892, turning out 600,000 fry that year, and increasing until the present year, when about 5,000,000 eggs were hatched. The stream on which this hatchery is located is known as a poor salmon stream. There have been as yet no returns from the hatchery work, but the fishermen on the southwestern coast of Prince of Wales Island believe that Mr. Callbreath's fish are coming to their streams.

EEKE INLET.

This is a small arm making into the peninsula opposite Hetta and separating Hetta Inlet from Sukkwan Strait. It is narrow, about a mile long, and has a general east-and-west direction. About one-fourth of a mile from its head lies the mouth of a stream—a lake outlet—15 feet wide and about 6 inches deep, which carries red salmon. At low water the stream discharges over a cascade, and about 100 yards from the entrance is a fall a few feet high, and which is about high-water mark. Above this the stream is sluggish and opens into shallows and pools varying in width from 50 to 300 yards. A mile from the entrance the stream opens into the lake, which is about a mile long with a greatest width of half a mile. It lies at the foot of a mountain ridge and runs about west-northwest and east-southeast. The bottom of the lower part of the stream is clear rock; the upper part, where it opens out, could not be examined for want of time. Part of an old barricade was found between the entrance and high-water mark.

The Klawak cannery has taken a few scattering redfish here, but never more than 1,000 during a season. In 1896 the Hunter Bay fishermen took 8,688 redfish from Eeke between July 10 and the latter part of August. In 1897 they caught 9,213 redfish from July 14 to September 26; 473 cohoes from August 16 to 31; 25,400 humpbacks from July 31 to August 31. A few fish were salted here in 1896.

The stream may be said to have an annual value of 7,000 redfish.

SUKKWAN.

Leaving Eeke and passing around the point, up Sukkwan Strait to the westward about 5 miles, is the village of Sukkwan, consisting of a saltery and about a dozen houses and shacks. The village is on a bay, about a mile long and of the same width, at the head of which is the salmon stream. A few scattering redfish only are taken, the run consisting of cohoes, and humpbacks; the former run from August 5 to September 30, and the latter from July 20 to August 25. The Klawak cannery in 1890 took 4,403 cohoes between September 5 and 7; and 607 in 1897, between August 21 and 30. In 1896 the Hunter Bay cannery obtained from Sukkwan 4,830 cohoes from the last of August to September 20; and in 1897 it took 3,317 cohoes from August 24 to September 26.

The saltery is operated by Banter & West, who this year (1897) packed about 300 half-barrels of humpback bellies, selling their fresh fish principally to the canneries. So far as could be learned, this saltery has never packed more than 200 barrels; in 1896 the output was 175 barrels of cohoes.

They use one drag seine, 70 fathoms by 6 fathoms, with 2¾-inch mesh.

KASSOOK INLET.

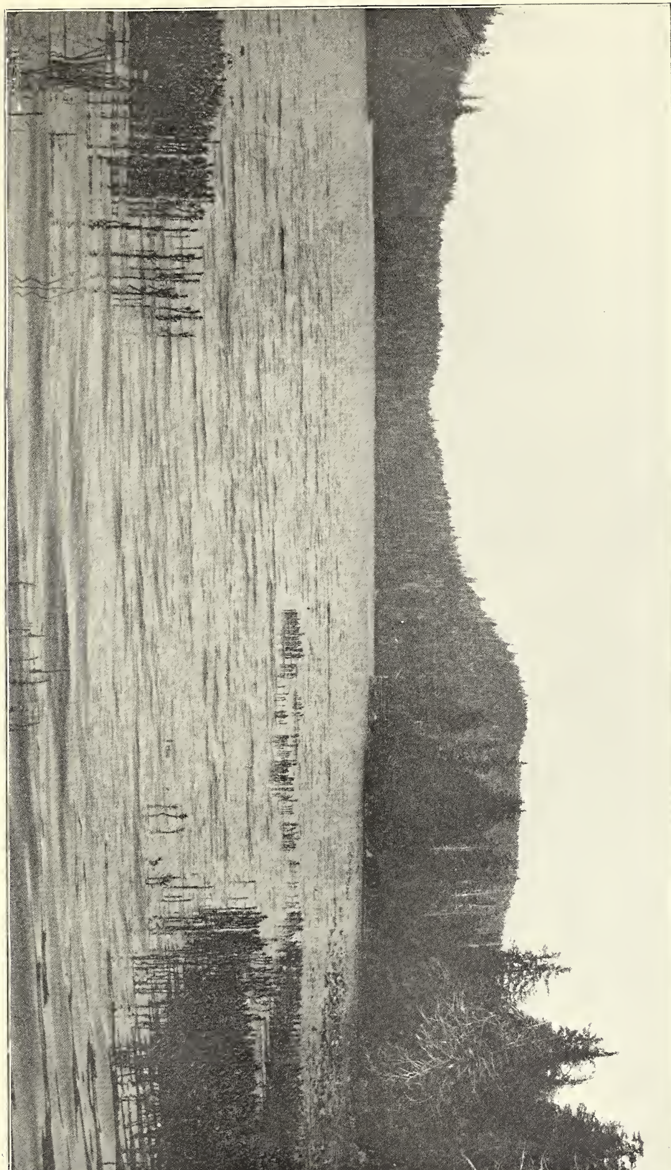
Kassook Inlet extends into Sukkwan Island in a general northwesterly and southeasterly direction from a point about 2 miles west of Jackson Island. It is about $2\frac{1}{2}$ miles long and from one-fourth to one-half mile wide. Near the head of the inlet on the western side a saltery was, at the time of our visit, in course of construction by Miller & Co., of Klinkwan, with the intention of salting humpback bellies and selling redfish to Loring and Klawak. An Indian shack is on the opposite side of the inlet.

Saltery at Kassook.

At the head of Kassook Inlet is the mouth of a lake outlet. It is only a small, shallow stream about 20 feet wide. At the point of high-water mark, where the width is about 20 feet between banks, is an old barricade. Above this the stream is rough and rocky, and flows from a rocky slough 200 yards beyond, which is a part of the lake and is about one-fourth of a mile long by 100 yards wide. This slough, as well as the lower part of the lake, is covered with pond lilies.

The lake proper is about three-fourths of a mile long in a general northwest-by-west and southeast-by-east direction, the upper part circular and about half a mile in diameter. The surface is only about 10 feet above high water. The shores are flat and wooded, grassy in places, especially near the feeders, of which there are several near the head and on each side of the outlet. There are some sand and gravel beaches. The entering streamlets average about 12 feet between banks, with a very slight flow at the time of our visit, but the indications are that they discharge a considerable amount of water during the rains. Around the mouth the bottom is sandy and expands into pools. The water of all these lake outlets is slightly discolored.

KASSOOK LAKE, FROM OUTLET.



It is said that in prospecting this inlet several years ago 10,000 redfish were taken in two weeks; but this statement should be received with caution, as no available records bear it out. In 1897 the cannery at Klawak took from Kassook stream 1,361 redfish; in 1888 it took 1,829 redfish from July 11 to 24, and a few hundred have been taken in subsequent years when the cannery steamer with a fishing gang was in that vicinity. In 1896 the Hunter Bay cannery took 1,340 redfish during July; in 1897 it took 1,054 redfish between July 14 and August 1, and 20,456 humpbacks from August 1 to August 31.

A fair estimate for the capacity of the stream would be 4,000 redfish.

GENERAL FEATURES OF HUNTER BAY REGION.

The foregoing streams (Nichols Bay, Hessa, Tar, Hunter Bay, Klakas, Nutqua, Hetta, Eeke, Sukkwan, and Kassook) supply fish to the Hunter Bay cannery. In addition, there are two small streams on Dall Island, from which together only 3,600 redfish were taken in 1896, and 812 in 1897. These were not visited. In 1897 the same cannery took also, from scattering localities in the region, 7,885 cohoes from August 24 to September 26, and 23,020 humpbacks from July 20 to August 31.

The earliest red salmon to arrive in the district are scattering individuals, which may be seen jumping as early as June 20, in the vicinity of Hetta, where they seem to make their appearance before they do at Hunter Bay. By July 4 small schools have usually arrived, and from the 8th to the 15th they increase in large numbers until the height of the run, from July 15 to 25. From the latter date to August 1 they commence to decrease, and after August 1 they are taken in connection with other salmon—cohoes and humpbacks—though they continue in good condition for packing until August 20. There is, however, great variation in the length of the runs on account of the small streams, which are much influenced by wet and dry seasons, as instanced in 1896 (which was very dry), when red salmon were packed until the 20th of September at the Hunter Bay cannery. Thousands of fish may be held at the mouth of a stream by the low water, and the rain of a single night may raise the stream sufficiently to allow the whole school to ascend in one body. The average weight of redfish packed at the cannery is under 6½ pounds. Those coming from Nichols Bay average nearly 8 pounds.

Cohoes are taken from August 1 to October 20. Their run is chiefly between August 15 and September 15. As the canneries close about September 20, the last of the run is not packed. The cohoes average much larger than the redfish, but they also require more water in the streams, and if the rains are late the run is correspondingly extended. The average weight of cohoes packed at Hunter Bay cannery is 9 pounds, but some weigh as high as 20 pounds. Cohoes are not very plentiful in any one place in Alaska, but they are found scattering in all localities. They have not been sought to any great extent, as the run is small and continues after the canneries close. Next to the king, they are probably the best salmon for the table on the Pacific coast, either fresh or canned; but most people eat salmon by color and reject the coho because it is paler than some other species.

Humpbacks are taken in large numbers from July 25 to August 25, subject to variations due to the stream conditions, but scattering fish are taken before and after these dates. When this fish first comes in from the sea it is in excellent condition for canning, and remains so for about a month; then it begins to deteriorate, the hump on the male growing rapidly, and the flesh becoming watery and poor. The average

weight is from 3½ to 4 pounds. On account of the pale color the humpback is not in favor, and in fact is considered a nuisance in salmon districts, yet it is used for salt bellies, and makes up the pack on short runs of other species. In my opinion, it is an excellent fish and will only be justly appreciated when the redfish become scarce.

Dog salmon run from August 1 to October 1, and are not used in this section.

When the Hunter Bay cannery was built, in 1896, the field was comparatively new with the exception of the stream at Hetta, which had been fished for years by the Klawak cannery. The other streams supplied the Miller salteries, and as they were acquired by the Pacific Steam Whaling Company the field was clear. The fisheries were conducted entirely by the cannery fishermen with cannery gear, and the product was received at the cannery at very little expense. It is said that the output for 1896 paid largely for the plant. In 1897 some fish were purchased at the rate of $6 per 100 for redfish and 50 cents per 100 for humpbacks.

In 1897 the strong opposition of cannery interests brought a competitor into this field. During our visit a saltery was in process of construction in Hunter Bay by the Alaska Packers' Association, as a branch to their Loring cannery. It is on the southern shore of the bay, a mile from the entrance. The output in 1897 of salt fish from this establishment was 500 half-barrels of humpback bellies and 500 barrels of redfish and cohoes.

At Wrangell a gentleman connected with the customs service reported that a stream on Dall Island was tightly barricaded. He had passed by Hunter Bay while we were there, en route to Howkan on duty, and it was probably on this trip that he visited Dall Island.

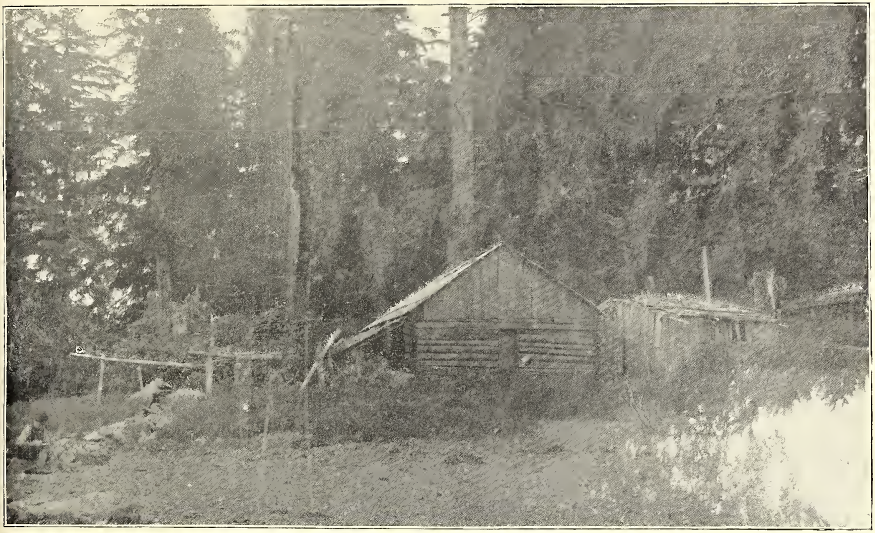
The stream at Hetta probably offers a good locality for a hatchery for this section. There is a large supply of fish and plenty of water, which, however, would have to be tested for temperature. The drawback is that it is not accessible, being off the calling routes of steamers.

MOIRA SOUND—KEGAN.

From Nichols Bay, around Cape Chacon, on the eastern coast of Prince of Wales Island, no streams are fished for the canneries until Moira Sound is reached, the entrance to which is 24 miles northward of Cape Chacon.

The stream called Kegan (the name of the Indian who claims it) empties into the western end, at the head of the first bay on the southern side of Moira Sound, about 3½ miles from Egg Island. The entrance to the bay is somewhat obstructed by islands and rocks. At the head of the bay, near the mouth of the stream, are several good seining beaches, and on the right bank, near the entrance, is a fisherman's house, a shack in which are stored seines and nets, two canoes, and a large seine boat.

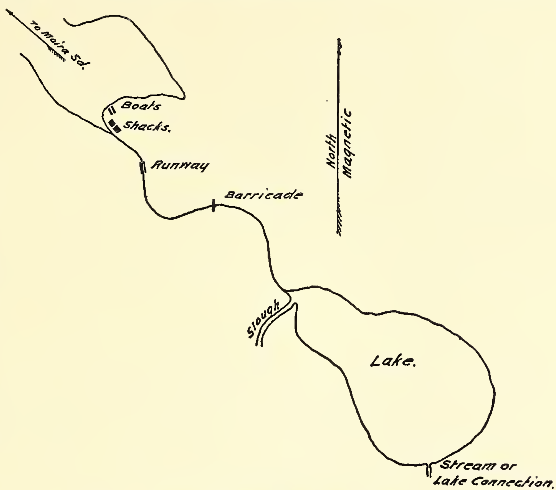
The stream is a lake outlet, about 2 miles long, flowing in a general northwest direction. It has an average width of 30 feet between banks, and when visited was 3 inches deep over a 10-foot riffle. Immediately above high-water mark there is a runway 75 feet long, 8 feet wide at the lower end and 12 feet at the upper, constructed of stone and rails. Its use was evident, for on the banks four Indian traps were found constructed of split poles and withes, tubular in form, funnel-shaped at the lower end, about 15 inches in diameter, and at least 15 feet long, closed at the smaller end. They are no doubt used in the runway. Half a mile above this point are the remains of an old barricade, and 50 feet above this, where the stream passes



FISHING CAMP, SOUTH SIDE OF MOIRA SOUND.

A TRIBUTARY TO HETTA LAKE.

between two rocky points about 25 feet apart, is a barricade of more recent build, with portions of the central slats removed, probably by the action of the stream. It is constructed in the usual manner, with the top log about 5 feet above the surface of the water. The bottom, from the high-water mark to this point, is composed of fine gravel, continues coarser for half a mile, and is then rocky, with rapids and low falls, to the lake.



Sketch of Kegan Lake and Outlet.

The lake is about 40 feet above high water, about $1\frac{1}{4}$ miles long, and from one-fourth to one-half of a mile wide, and has a general northwest and southeast direction. The shores are heavily wooded and rocky, and the bottom around the mouth of the outlet is gravelly. On the southern side, near the outlet, a grassy slough, about three-eighths of a mile long and 50 yards wide, makes out from the lake. There were no means to make a thorough examination of the lake, but from the outlet the shore at the head looked as if it were grassy at the edge, with two streams entering, the main one coming from the southwest.

The following is the record of the salmon catch of this stream from 1892 to 1897, both inclusive:

Year.	Redfish.		Cohoes.		Humpbacks.	
	Dates.	Number.	Dates.	Number.	Dates.	Number.
1892	July 15 to Aug. 23	16,795	Aug. 5 to Aug. 23	191		
1893	July 25 to Aug. 30	10,265	Aug. 17 to Aug. 30	324	July 30 to Aug. 12	6,365
1894	July 13 to Aug. 23	18,739	Aug. 3 to Aug. 23	362		
1895	do	27,950				
1896	July 10 to Aug. 31	29,775	Sept. 5 to Sept. 9	384	July 27 to Aug. 21	5,446
1897	July 21 to Sept. 2	23,281	July 21 to Sept. 2	840	July 21 to Aug. 28	47,500

It seems that about 20,000 redfish can be taken from this stream annually. Until 1896 it supplied Metlakahtla exclusively; but Loring received 2,528 redfish in that year and 7,137 redfish, 250 cohoes, and 29,500 humpbacks in 1897.

There are no houses on Moira Sound having permanent occupants, and as no one could be found in the locality our work was somewhat retarded, the information pre-

viously obtained from the Indians being rather indefinite. We therefore explored all the streams, and by this time our parties were sufficiently expert to recognize the red-salmon streams by certain signs, whether the fish were running or not.

OLD JOHNSON STREAM.

The next redfish stream in the Moira Sound region is known as Old Johnson Stream. It empties into a V-shaped indentation on the northern shore of Moira Sound opposite the entrance of the bay into which Kegan Stream empties, 3½ miles in a straight line from Egg Island. This indentation opens into a very pretty basin, into the upper end of which the stream empties with a fall of a few feet. On the northern side of the basin, near the mouth of the stream, are two houses, in which were found seines and fishing gear, a canoe being housed near by; and on the same side, near the entrance to the basin, is a fishing shack. The general course of the stream is west-southwest. It is about a mile in length, and 30 feet wide between rocky and heavily wooded banks. It carries considerable water, with a strong current for the greater part of its course. Inside the mouth is an island, the stream widening out above, forming a cove on the left bank, which is crossed by a footbridge. Above this it contracts again, but at two other points it expands into shallows 150 yards wide. On the left bank, abreast the island, a tree has been felled across, and above the footbridge split rails and heavy gratings, 5 by 8 feet, were found, which, when applied to the fallen tree, would form a barrier.

The outlet at the lake is much obstructed by a natural barrier of drift. The lake was not examined, but judging from the flow at the outlet it must receive a large amount of water. It is approximately 4 miles long and 2 miles wide, with moderately steep, rocky sides. Two branches were noticed to the right and left, which may be entering streams connecting with other lakes, or they may embrace an island.

The following is the record of this stream for six years:

Year.	Redfish.		Cohoes.		Humpbacks.	
	Dates.	No.	Dates.	No.	Dates.	No.
1892	July 18 to Aug. 8	4,482	Not known	40	Not known	357
1893	July 22 to Aug. 15	4,119			July 25 to Aug. 25	15,329
1894	July 11 to Aug. 15	11,863			Aug. 6 to Aug. 15	4,083
1895	July 15 to Aug. 17	15,558			July 20 to Aug. 16	3,287
1896	July 8 to Aug. 21	10,798	Sept. 8	260	July 28 to Aug. 2	14,352
1897	July 19 to Sept. 1	8,428	July 27 to Sept. 13	2,521	July 19 to Aug. 28	54,765

The fish from this stream went exclusively to Metlakahtla until 1896. In that year the Loring cannery received of the above catch 3,600 redfish, and in 1897, 3,434 redfish, 1,100 cohoes, and 38,000 humpbacks.

The capacity of the stream is about 10,000 redfish.

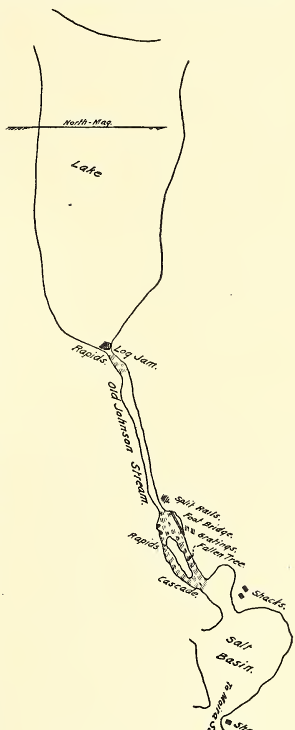
OTHER STREAMS OF MOIRA SOUND REGION.

On the long arm to the southward in Moira Sound, and about 2 miles from its head, on the eastern shore, is the mouth of a stream which, at the time of our visit, was very low. The distance from high-water mark to low-water mark is one-fourth of a mile. The stream between banks is from 30 to 50 feet wide, but the flow over a log was only 5 feet in width and 2 inches in depth. From appearances, in heavy rains, it carries a large amount of water, as it seems to drain a high mountain system. The stream is tortuous, but has a general west-by-south and east-by-north direction. For

WIDENING OF STREAM DRAINING LARGE LAKE, NORTH SIDE OF MOIRA SOUND.

SPAWNING BEDS IN STREAM NEAR HEAD OF SOUTH ARM, MOIRA SOUND.

a few hundred yards at the mouth the banks are open and grassy and then heavily wooded. The bottom is of sand and gravel, the water spreading over it, with deep holes in places and very little current. It flows between two mountains, the northern being wooded to the top, the southern about 2,000 feet high and wooded to a height of about 500 feet; above this it was bare, with snow patches. The stream was examined for about three-fourths of a mile in a straight line, and no lake was discovered from a hill from which a view could be obtained. There were no barricades, except a few natural obstructions formed by fallen trees against which drift had found lodgment. The water is clear. About the mouth are excellent seining beaches. From the absence of fishing shacks and gear and barricades in the stream, and the clear water, it was concluded this was purely a humpback stream, and this supposition was afterwards confirmed by a Kasaan chief, Skowl, and cannerymen.



Vicinity of Old Johnson Stream.

At the head of this southern arm of Moira Sound are two small brooks emptying into separate bights. The one to the eastward is a mountain stream flowing over a rocky bottom, and has its source in the vicinity of the bare mountain previously mentioned. This bight has, at its head, a fine gravel beach about half a mile long, bordered by a grassy bank 100 yards wide, with the heavy timber beyond. Moderately high hills surround the inlet.

The western stream flows into a similar bight, where there is a long gravel beach at low water. The shore is grassy, with salt-water pools through it. The bottom of the stream is rocky, and it has its source in the back hills. Both streams had very little flowing water, but as they drain a hill country, it is probable that they are greatly swollen during rainy weather. They are both humpback streams.

At the western extremity of Moira Sound are two inlets, the southern one having at its head a small brook running over a slaty bottom. The head of the arm and a large part of the northern beaches are gravelly. This is not a redfish stream, but probably contains humpbacks and a few cohoes.

These are all the streams that enter Moira Sound, and the only ones that contain redfish are Kegan and Old Johnson. The cohoes and humpbacks credited to these two streams probably come, in part, from the other streams. It is the custom to establish fishing-camps on redfish streams and to fish all others in the vicinity for the different species.

NIBLACK ANCHORAGE.

Niblack Anchorage, between North Arm and Moira Sound, has a stream entering about midway on the northern shore behind a high-tide island which forms a part of the inner harbor. It is of large volume, about half a mile long and 30 feet between banks, and flows with considerable velocity over rapids and falls. No stream could be seen flowing into the lake at its head and the latter seems to be fed by cascades, one of which is quite large. The shores are for the most part precipitous, rocky, and inaccessible except by boat. The Kasaan Indians say that no redfish are taken here and there are no signs that it is a redfish stream. It is probable that salmon can not work their way over the falls and rapids.

NOWISK-KAY.

Nowisk-Kay is the name at present given to the stream which flows from the lake into North Arm. It is a little over a mile in length, averaging 30 feet in width by 18 inches in depth, and has a general east-and-west direction. An Indian of that name claims to be the owner of the stream. The bottom is rocky, covered with bowlders, and the banks are precipitous, rocky, and heavily wooded. About 500 yards from the mouth are the remains of a barricade—a tree had been felled, cut to make a tight fit in the rocky ledges on either side, and then supported in the usual manner. Most of

Sketch of Nowisk-Kay Stream.

the split rails had been removed or carried away by freshets, but a large number of poles or rails, such as are used for the top course of a barricade, were found near the bank, some of them newly cut. On the northern bank, near the barricade, were found two large rolls of wire netting, apparently recently placed there. With these means at hand it is probable that two men in a day's work could have effectually barricaded the stream.

There were no means available to examine the lake. From the head of the outlet all that can be seen is an arm about 2 miles long and 200 to 300 yards wide, which is probably the connection with the lake proper. It is about 20 feet above the sea level, has steep, rocky banks, and appears deep. Judging from its flow at the outlet it must receive a large body of water, either from inflowing streams or other lake connections.

The following is the fishing record of Nowisk-Kay Stream for six years:

Year.	Redfish.		Cohoes.		Humpbacks.	
	Dates.	No.	Dates.	No.	Dates.	No.
1892	July 13 to Aug. 6	3,168			July 29 to Aug. 6	2,965
1893	July 31 to Aug. 31	6,671	Aug. 17 to Aug. 31	200	July 28 to Aug. 16	10,485
1894	July 14 to Aug. 23	8,346	July 10 to Aug. 23	1,002	July 30 to Aug. 9	808
1895	July 16 to Aug. 15	14,653			July 26 to Aug. 1	772
1896	July 15 to Sept. 5	12,885	Not known	102	July 27 to Aug. 21	11,864
1897	July 19 to Aug. 30	36,934	July 19 to Aug. 30	595	July 22 to Aug. 19	7,771

LAKE NEAR NIBLACK ANCHORAGE. VIEW UP LAKE.

CASCADE IN STREAM DRAINING LAKE NEAR NIBLACK ANCHORAGE.

The fish from this stream were supplied exclusively to Metlakahtla until 1896. In that year Loring received of the above catch 1,000 redfish, and in 1897 about half of the catch, except the humpbacks. The catch seems to be increasing in recent years, possibly from more vigorous fishing. It probably yields 15,000 redfish annually.

PETER JOHNSON STREAM.

The small inlet on the north shore of Point Adams was visited by portage from North Arm, but no stream was found. After leaving the locality it was learned that a red-salmon stream is located on the inlet. It is known as the Peter Johnson Stream, and will be the subject of a future examination. The fish from this stream are very small. The record for six years is as follows:

Year.	Redfish.		Cohoes.		Humpbacks.	
	Dates.	No.	Dates.	No.	Dates.	No.
1892......	July 8 to Aug. 18	8,434	Aug. 6 to Aug. 18	1,310	....	
1893......	July 10 to Aug. 29	17,154	....		Aug. 5 to Aug. 15	1,754
1894......	July 18 to Aug. 23	15,525	July 25 to Aug. 23	2,329	....	
1895......	July 6 to Aug. 16	17,874	July 26 to Aug. 30	1,979	July 24 to Aug. 2	1,465
1896......	July 8 to Aug. 2	21,700	——— to Sept. 10	1,900	Aug. 3 to Aug. 21	8,000
1897......	July 6 to Sept. 2	26,310	July 19 to Sept. 9	2,957	July 20 to Aug. 21	10,016

The above-mentioned fish were supplied exclusively to Metlakahtla until 1896. Loring received 6,300 redfish in that year, and 10,169 redfish and 1,500 humpbacks in 1897. The average catch of redfish, as indicated in this record, is 17,833 per year. It is believed, however, that the stream can produce at least 25,000, and a conservative estimate would be 20,000.

All these streams, from Kegan to Peter Johnson, are known as the Moira Sound streams, and are fished by the Indians claiming them, the product being sold to the canneries, except in the case of Loring. This cannery has purchased fish and sent fishing gangs to the locality. Drag seines are used in making the catch.

Reference has previously been made to the great difference in the weight of fish in different streams, and Moira Sound offers a striking example. The redfish from Kegan average about 5 pounds, those from Old Johnson, on the opposite side of the sound, run 6 pounds, and from Nowisk-Kay 7 pounds, the largest in the locality, while those from Peter Johnson run $3\frac{1}{2}$ to 4 pounds, the same as the Metlakahtla home stream and Tamgass Harbor. These are probably the smallest redfish in Alaska except those from Necker Bay, Baranof Island.

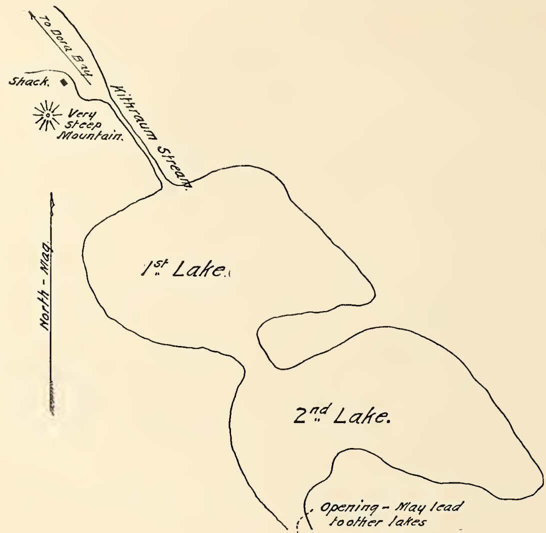
No reference has yet been made to the availability for hatchery purposes of the Moira Sound streams. At all the redfish streams fish, which could be easily corralled until ripe, are abundant and plenty of water can be obtained by gravity. The locality is inaccessible, being off the steamer routes; but the only real questions are the necessity of filtering the water and the range of temperature of water during the hatching season. As previously remarked, all the redfish streams in southeast Alaska have discolored water, and wherever lake water is used for hatchery purposes it should probably be filtered. A series of observations would be necessary to determine the suitability of the waters as regards temperature. The sun during the summer, when it does shine, warms the surface water considerably, and on being conveyed down a shallow stream the temperature is further increased.

CHOLMONDELEY SOUND AND KITHRAUM STREAM.

Cholmondeley Sound is the next body of water to the northward. Here there is but one red-salmon stream, those entering the heads of the other arms and inlets carrying only a few cohoes, humpbacks, and dog salmon.

Kithraum Stream flows into the head of the narrow inlet about 2 miles long that makes to the southward and eastward of Dora Bay, Cholmondeley Sound. It is about half a mile long and 15 feet wide, flowing with a strong current in a general northwest direction from a lake of which it is the outlet. The bottom and banks are rocky, and from its general appearance a large amount of water is discharged during the rainy season.

The outlet at the lake is badly choked by drift. No evidences of barricading were found. There are two lakes, each about a mile long and a half to three-quarters



Sketch of Kithraum Stream.

of a mile wide. The first is joined to a second by a passage about 60 yards across and extending in a general southeast and northwest direction. The lakes are surrounded by high, snow-covered mountains. The second lake has an outlet or wide passage at its southwest end, which was choked and prevented further examination in the very small canoe at our service. There was also a heavy jam of timber in the connecting passage. The inlet in the southwest end may lead to a third lake or receive an entering stream, but nothing could be seen. The waters of the lakes

PLATE 33.

LAKE NO. [illegible], DORA BAY, LOOKING TOWARD OUTLET.

LAKE NO 2, DORA BAY, LOOKING TOWARD NO. 1.

appeared deep and were slightly discolored. At the mouth of the stream were two shacks and some fishing gear. The fish are sold to Metlakahtla.

The records for three years are as follows:

Year.	Redfish.		Cohoes.		Humpbacks.	
	Dates.	No.	Dates.	No.	Dates.	No.
1894	July 17 to Aug. 18	6,972	Aug. 4 to Aug. 14	281	Aug. 4 to Aug. 11	9,810
1896	July 8 to Aug. 22	5,695	(Dates not known)	44	July 28 to Aug. 20	8,914
1897	July 19 to Aug. 27	9,000	Aug. 17 to Aug. 27	600	July 21 to Aug. 21	3,800

The average catch is 7,222 redfish, and the stream could probably supply 8,000 per year. The stream is claimed and fished by an Indian, Kithraum.

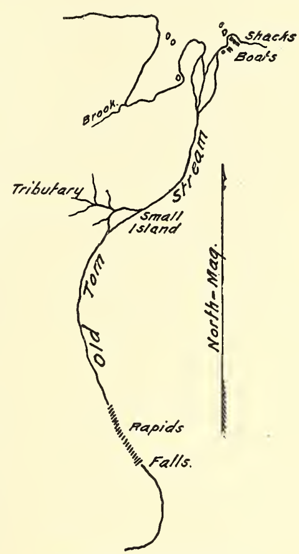
From Nichols Bay to and including Cholmondeley Sound there seemed to be no permanent dwellings.

SKOWL ARM AND OLD TOM STREAM.

We next came to the territory fished exclusively for Loring, and including Skowl Arm, Karta Bay, and Kasaan Bay Stream.

Skowl Arm has two redfish streams, neither producing a large number.

Old Tom Stream has its mouth at the head of the first bight immediately west of the first, long deep inlet opening into Skowl Arm from the southward. It is opposite Kasaan village. The stream enters the eastern side of the bight, where a small inlet is formed, having a narrow entrance and opening out into a grassy flat one-fourth of a mile long and one-eighth of a mile wide. High water extends about 200 yards above the entrance. In the small inlet there are good gravel seining-beaches. At the mouth of the stream on the right bank are two shacks, a smokehouse, a canoe, seine boat, fish float, and some fishing gear. There were no evidences of barricading in the stream, which is tortuous, and has a general north-and-south direction. For $1\frac{3}{4}$ miles the bed is fine sand and gravel, with rocky riffles. Its width diminishes from 30 feet to 15 feet, and it rises about 20 feet in the distance named. Then for three-eighths of a mile it runs as a rapid over a rocky bed, at the end of which is an almost perpendicular fall of about 20 feet, with a deep pool below. The fall in this reach is about 40 feet. For half a mile above the fall the stream diminishes rapidly in volume and runs over a rock and gravel bottom.



Sketch of Old Tom Stream.

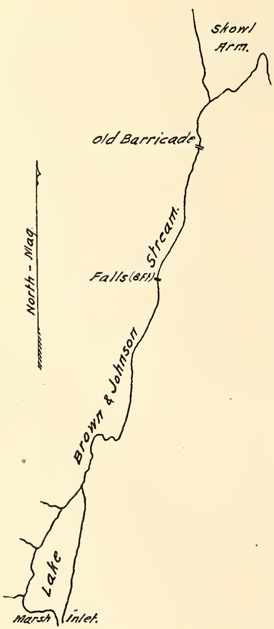
Considerable water drains from the western side, which is an open grassy and wooded slope. On the eastern side the mountains come to the bank of the stream. About halfway up, the stream, in running over a log, was noticed to be 10 feet wide and $2\frac{1}{2}$

inches deep. In several places there are natural obstructions formed by drift. About a mile from the mouth it receives from a grassy flat filled with pools a small tributary on the left bank. This tributary was examined for one fourth of a mile in a general westerly direction and found to be simply a rill flowing between pools, with grassy banks about 5 feet apart. The bottom generally was sandy, with vegetable sediment in the pools. The water is dark, and discolors the main stream, which above is clear.

The only records of Old Tom Stream available are for 1896 and 1897, and are taken from the cannery books at Loring:

Year.	Species.	Dates.	Number.
1896	Redfish	July 27 to Aug. 14	2,310
	Cohoes	Sept. 1 to Sept. 16	1,925
1897	Redfish	July 20 to Aug. 21	3,000
	Cohoes	Sept. 1 to Sept. 10	600

The Indians state that in 1896 about 4,000 redfish were taken from this stream, and that the tributary is a lake outlet. The party examining it found no lake, unless the pools and shallows form a lake during the rainy season. The annual yield of the stream is probably about 3,000 redfish, averaging 5 pounds in weight.



Sketch of Brown & Johnson Stream.

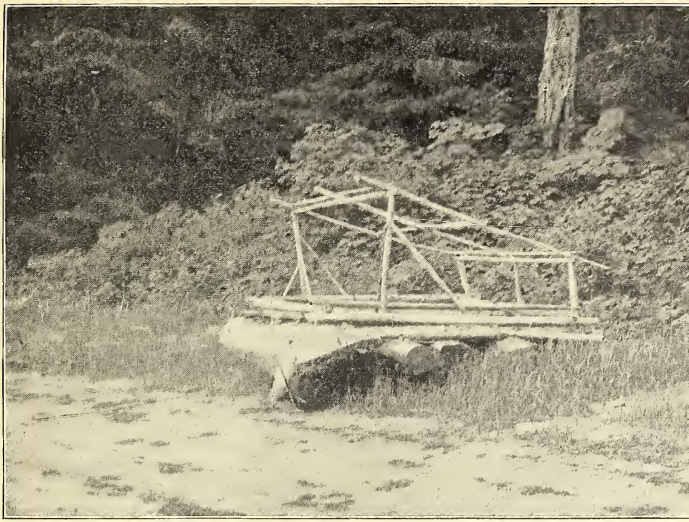
BROWN AND JOHNSON STREAM.

On the western shore of Skowl Arm, where it bends to the southward, and opposite the northern end of a large island, is the mouth of the Brown & Johnson Stream. It is about 1½ miles long, 30 feet wide, and rises about 50 feet above high water to the lake of which it is the outlet. It flows in a general north-northeast direction from the lake, with a strong current, over a bottom which is generally rocky and bowldery, but in some places sandy and gravelly. It is comparatively free from natural obstructions.

A few hundred yards within the mouth are the remains of a barricade of the usual construction. The central poles have been removed or carried away, but could easily be replaced. About halfway up, the stream falls in a cataract 8 feet high. The lake is approximately half a mile long by 400 yards wide. It lies in a marshy basin, though the center seems deep and there are some sloping sandy beaches. It is fed by small streams, with sandy and gravelly bottoms. At the head is a narrow inlet, but on account of having no facilities at hand it could not be examined. It may connect with another lake or with an entering stream. The volume of water at the outlet indicates there must be some large feeder.

The only available records of this stream are from the cannery books at Loring:

Year.	Species.	Date.	Number.
1896	Redfish	July 27 to Aug. 14	2,310
	Cohoes	Sept. 1 to Sept. 16	1,925
1897	Redfish	July 30 to Aug. 16	1,770
	Cohoes	Aug. 23 to Sept. 3	700



Skeleton of the floating fish-house at Skowl Arm.

Brown & Johnson Stream should produce about 2,000 redfish per year, all of which go to Loring. The average weight of the fish is about 5 pounds.

There are other salmon streams at the ends of the arms making to the southward from Skowl Arm, but they contain only cohoes, humpbacks, and dog salmon. The village of Kasaan is situated on the northern shore of Skowl Arm, 3 miles within the entrance and out of the steamer track. Some of the old houses remain and many interesting totem poles may be seen.

KARTA BAY.

Karta Bay is at the northwestern end of Kasaan Bay (called Kasan Bay on Chart A), of which it forms a part. The saltery on the cove directly east of Karta Bay proper, known as Karta Bay or Baronovich Fishery, was one of the first operated

in southeast Alaska. A redfish stream empties into the head of Karta Bay about a mile from the saltery. A Greek, or Slav, Baronovich by name, many years ago married the daughter of Skowl, one of the old-time chiefs of the Kasaans, and received from him this fishery, which has been one of the most productive in southeast Alaska. Baronovich lived at the saltery, where he packed fish (about 400 barrels a year), kept a store, and traded with the Indians. He died some years ago. The saltery, wharf, store building, and several houses are still standing, but all are deserted. Baronovich's sons, who during our visit were there to conduct the season's fishing, were housed in shacks in a bight on the eastern shore of Karta Bay proper.

For a number of years the Cutting Packing Company, then operating the cannery at Loring, leased the stream, paying $300 a year to the widow of Baronovich, but in 1893, when the cannery passed into the hands of the Alaska Packers' Association, the lease was relinquished. The run of 1892 was so small that it did not warrant the cannery in holding the stream. On account of the low price of salt fish, the saltery has not been in operation, except in a desultory way, for a number of years. The Baronovich sons have still about 100 barrels of a lot salted at a loss a few years ago. This year (1897) they salted 41 half-barrels of humpback bellies.

It appears that one of the first chiefs of the Kasaans, Sanhite (Billy Wilson), also has Indian fishing rights in the Karta Bay stream, and, with his fishing crew, conducts a separate fishery. He has a large house at Kasaan, but during the summer season lives in the Indian village at the mouth of the stream, where there are about a dozen houses and shacks.

It is said that during the lease of the stream by the Loring cannery it was barricaded, and that an Indian was paid $2 a day to keep the barricade perfectly tight. The cannery people say that the fencing was done by those claiming the fisheries. It is also said that on account of the rapid decrease of salmon the barricade was removed in 1892, which explains the big run in 1896; in 1893 the stream was closed, and a small run in 1897 was expected. The stream has been open since 1893.

At Loring it was positively stated that the Karta Bay stream was barricaded in 1892, that it was open in 1893 and 1894 and very little fishing done, and was probably closed in 1895.

In 1896 the cannery steamer took to Loring from this stream 84,545 redfish. Of this number Baronovich Brothers sold about 47,000, and Sanhite about 37,000. The price paid was $5.50 per 100. The fish are said to be of a large variety and to run 7 pounds in weight during the season. At the time of our visit about 100 redfish were taken at one haul; 25 of these averaged 6½ pounds, the largest 9 pounds, the smallest 5 pounds. The Indians state, however, that the first fish are always small and that they average much higher as the run increases.

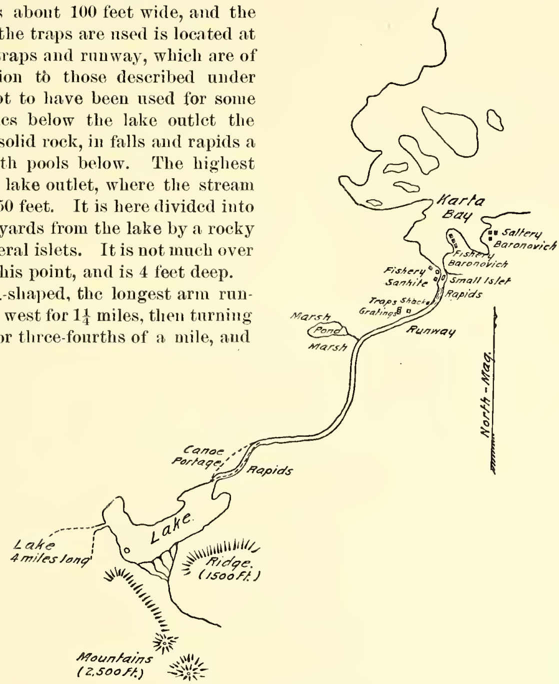
KARTA BAY STREAM.

Karta Bay Stream is said to have perhaps the earliest run of redfish in southeast Alaska. Fishing has commenced here on June 4, though that was an exceptionally early date. In 1897, on June 13, some salmon having been seen jumping, a haul was made and 100 redfish were taken. No other haul was made until June 25, when 600 were taken and sent to Loring. It is a great, wide, beautiful stream, with a large volume of water that comes tumbling down over the rapids with considerable velocity, and is more worthy of the name of river than the streams previously visited.

LAKE NEAR KARTA BAY.

The bed of the stream is rocky, interspersed with bowlders and coarse and fine gravel. The banks are rocky and precipitous and covered with heavy undergrowth. Mountains impinge close on the banks. From the Indian village the general course of the stream is to the southwest, and, with its meanderings, it is about 4 miles to the lake, the distance in a straight line being about 3 miles. It varies from 100 to 300 feet in width. About one-fourth of a mile from the mouth is an Indian shack in ruins, and stored inside were a number of Indian traps and large gratings, which, in some places, are used for barricading streams. Here the river is about 100 feet wide, and the runway in which the traps are used is located at this point. The traps and runway, which are of similar construction to those described under Kegan, appear not to have been used for some time. For 2 miles below the lake outlet the stream runs over solid rock, in falls and rapids a few feet high, with pools below. The highest rapids are at the lake outlet, where the stream drops 12 feet in 150 feet. It is here divided into two parts for 100 yards from the lake by a rocky ledge forming several islets. It is not much over 20 feet across at this point, and is 4 feet deep.

The lake is L-shaped, the longest arm running southwest by west for $1\frac{1}{4}$ miles, then turning north-northwest for three-fourths of a mile, and is from one-fourth to one-half mile wide. Near the end of the arm a narrow inlet communicates on the same level with a second lake, which is said to be 4 miles long and from 1 to $1\frac{1}{2}$ miles wide, with a number of inflowing streams. The first lake has one stream emerging from a valley between two snow-capped mountains near the southern shore of the upper arm, and entering the lake from a large, sparsely wooded flat, in a dozen or more streamlets having grassy banks and fine gravel and sand bottom. These streamlets cover about three-eighths of a mile of the lake shore. The central part of the lake seems deep, though there are a few shoals, one appearing at the surface; along the shores it is shallow. The banks are mostly grassy, with sand and gravel beaches. The lake is about 60 feet above the level of the sea, and the stream falls 30 feet in the first half mile.



Sketch of Karta Bay Stream.

This seems an excellent locality for a hatchery, as there is a harbor, abundance of water by gravity, plenty of fish, and at the mouth of the stream a natural basin that could be easily arranged for holding fish until ripe.

The records of Karta Bay Stream are incomplete. The following is all that could be found. The first date, July 3, 1897, is not the date of the first fish taken, but the date when the cannery began operations. The first fish taken were on June 13, and 600 were sent to the cannery on June 25.

Year.	Species.	Dates, etc.	Number.
1888.	Redfish	In June (first on the 20th).	2,178
	Do	In July	22,760
	Do	In August, to 25th.	5,082
		Total	*30,020
	Cohoes	From Aug. 19 to Sept. 7.	*1,739
1889.	Redfish	In June (first, 670 on the 26th).	2,176
	Do	In July	9,542
	Do	In August, to 17th.	2,499
		Total	14,217
	Cohoes	From Aug. 17 to Sept. 16.	6,027
1890.	Redfish	In June (first, 2,995 on the 21st).	17,223
	Do	In July	23,415
	Do	In August, to 4th	2,150
		Total	42,788
	Cohoes	No record.	
1891.	Redfish	In June (first, 4,250 on the 18th).	21,012
	Do	In July	47,864
		Total	68,876
	Cohoes	No record.	
No record whatever could be obtained for 1892, 1893, and 1894. The run in 1892 was very small, and in 1893 and 1894 very little fishing was done.			
1895.	Redfish	July 13 to 31	5,631
	Cohoes	August 1 to 18	1,826
†1896.	Redfish	In June (first on the 20th).	7,258
	Do	In July	71,837
	Do	In August, to 14th.	5,450
		Total	84,545
1897.	Redfish	From July 3 to Aug. 16.	23,000
	Cohoes	From Aug. 26 to Sept. 17.	2,500
	Humpbacks	From July 27 to Aug. 16.	36,000

* These fish made 3,343 cases, Naha Brand, redfish and cohoes packed together; 9 to the case, or an average weight of over 7 pounds.

† The catch of redfish from this region in 1896 was a surprise to every one acquainted with the subject, notwithstanding that this was a remarkable year in southeast Alaska.

It is generally believed that Karta Bay will, under average conditions, yield 35,000 redfish per annum, and, if kept free from barricades, there seems no reason why that number should not be doubled in the future.

KINA.

There is another small stream in Kasaan Bay, which has a small run of redfish. It is known as Kina, and empties into the bight next west of Coal Bay. All the fish go to Loring. The stream might supply 2,000 redfish annually. The only record available is as follows:

Year.	Species.	Dates.	Number.
1896	Redfish	July 29 to Aug. 23	2,018
1897	do	July 19 to Aug. 16	1,500
	Cohoes	Aug. 8 to Sept. 4	470
	Humpbacks	July 19 to Aug. 16	15,000

At the head of Twelve Mile Arm, and on the western shore, are streams containing cohoes or humpbacks, or both; but the Karta Bay and Kina streams are the only ones in Kasaan Bay and its branches that have redfish.

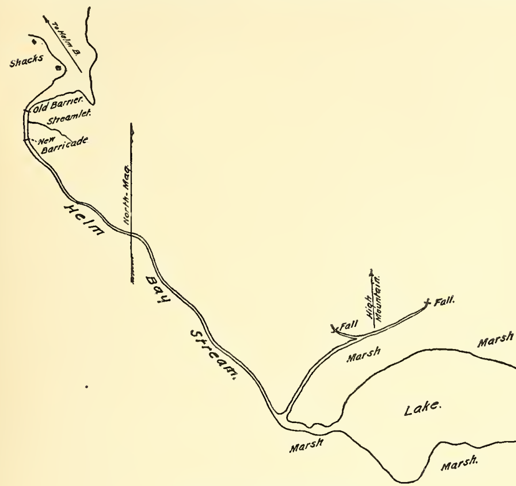
In July, 1889, the Loring cannery received from Kasaan Bay, from July 27 to September 16, 1,304 redfish and 5,219 cohoes, paying 8 cents each for redfish and 14 cents each for cohoes.

FISHING HUTS ON SKOWL ARM, KASAAN BAY.

STREAM AT DORA BAY, LOOKING OUT.

HELM BAY.

Helm Bay opens into Behm Canal from the southeast part of Cleveland Peninsula. A small redfish stream empties into the V-shaped indentation on the northern shore of the bay, about midway of its length. At the time of our visit it discharged very little water. It has a general northwest-and-southeast direction, is from 1½ to 1¾ miles long, with sandy and gravelly bottom, and is about 15 feet wide.



Sketch of Helm Bay Stream.

The lake is about 50 feet above high water, and 1 mile long by ½ to ¾ mile wide. The banks are marshy, and the bottom appears sandy, sloping gradually from the banks to the center. Besides the tributary mentioned as entering between the two barricades, the main stream receives from the eastward another on the right bank, a little below the lake outlet. This tributary forks, each branch leading to a small fall.

On the point forming the bight is a rude shack in which were stowed some seines, and on the beach a flatboat was found. Within the mouth, and about the point reached by high water, are the remains of a barrier from which nearly all of the poles have been removed, but which would need only very little work to make it effective. A short distance higher up, above the mouth of a small tributary, is a barricade of recent construction, nearly intact, and lacking only two poles in the center to make it effective. Twine netting, badly damaged, was also found here, and was probably used in the construction of the barricade.

The following, the only record obtainable, is taken from the cannery books at Loring, where these fish are brought by the Indians who conduct the fisheries:

Year.	Species.	Dates.	Number.
1896	Redfish	July 13 to 31	2,990
	Do	Aug. 1 to 11	3,691
	Cohoes	Sept. 1 to 15	1,931
1897	Redfish	July 21 to Aug. 11	6,000
	Cohoes	Sept. 1	700

Helm Bay Stream should produce 6,000 redfish annually.

At the head of the bay is a humpback stream which was examined. Its high-water mark is on line with the edge of the timber, half a mile beyond the low-water mark. Between the two the upper part of the northern side is grassy, while the southern is rocky. From the latter, several streams enter which during high water fall, by cataracts about 30 feet high, into the bay, and at low water have their own beds and join the main stream, doubling its volume. The stream is from 20 to 30 feet wide between banks; has much sand and gravel on the bottom, making good spawning-beds for humpbacks, and is much choked by drift timber. At the time of our visit the water was low; across a riffle, 8 feet wide, it was only 4 inches deep. The banks are quite level and heavily wooded and the water is clear. As it was early learned that this was not a redfish stream, the headwaters were not examined. At the head of the bay on the northern side are good seining beaches.

NAHA BAY.

Naha Bay, an arm of Behm Canal, is on the western side of Revillagigedo Island opposite Helm Bay, and 10 miles within the southern entrance of the canal. Loring is a post-office, and is situated on the northern shore of Naha Bay. In 1890 it had a population of 200, which must have included the cannery-hands (Chinese and others), as the permanent population is very small. At the head of the bay a lake or lagoon receives the waters of the home salmon stream (Naha Stream), which formerly was so prolific that the Indians, in speaking of anything and desiring to express large numbers, would liken it to the salmon in Naha Stream. The cannery buildings, wharf, store, etc., are on the eastern point of a small cove on the northern shore, and circling this cove are the dwellings of the whites and others.

The cannery belongs to the Alaska Packers' Association, and in 1897 it had the largest output of any cannery in Alaska (62,040 cases), though the pack consisted largely of humpbacks.

A saltery was in operation here for many years prior to 1888, when the Alaska Salmon Packing and Fur Company, of San Francisco, built a cannery which was operated by the Cutting Packing Company. A pack has been made here every year since. In 1892 it joined with other canneries under the Alaska Packing Association, and in 1893, when the Alaska Packers' Association was formed, it joined that organization and has since been operated by it. The cannery originally had a capacity of about 400 cases per day. This by better methods was increased to 700, and in 1896 it was again enlarged and now has a capacity of 1,800 cases per day.

The cannery obtains fish from the home stream (Naha), Karta Bay, Kasaan, Union, and Helm bays, Moira Sound district, Quadra, Checats, and Ketchikan. The stream records are given under the proper headings, so far as they could be obtained, but the totals by streams will not give all the fish used, because in each district there are streamlets from which a few hundred, perhaps a thousand, are taken by the Indians and carried to the passing steamers or to the canneries. For instance, the total number of redfish used at Loring in 1896, as recorded by streams, is 207,732, while the number actually used was 216,000. With cohoes and humpbacks there are still greater differences, as cohoes are very much scattered and only a few are taken here and there, while the humpbacks run in such numbers and are so cheap that not much attention is paid to them, so far as districts are concerned. These fish can therefore only be referred to by localities in a general way, except when taken from a regular fishery.

STREAM AT HELM BAY.

In 1896 the Loring cannery obtained from various localities and packed 27,000 cohoes between August 5 and September 15, many of which are recorded under the streams described. The total number of humpbacks used at the cannery the same year was 784,263, of which number 361,738 were supplied by the home stream between July 18 and August 31 and 148,258 by Ketchikan between July 24 and August 31.

The following shows the packs of Loring cannery for 1896 and 1897:

Species.	1896.			1897.		
	Date.	Number of cases packed.	Number of fish per case.	Number of fish.	Number of cases packed.	Number of fish per case.
Redfish	June 19 to Aug. 31	19,621	11	131,567	10,470	11.8
Cohoes	Aug. 5 to Sept. 15	3,029	9	19,478	2,306	8.4
Humpbacks	July 18 to Aug. 31	38,365	20 to 21	1,124,610	49,264	23.0
Dog salmon	July 18 to Aug. 6	452	6½			
Total		61,467			62,040	

NOTE.—This cannery is also credited with the following salt salmon in 1897: 216 barrels redfish, 324 barrels cohoes, and 1,449 barrels humpback bellies. No salmon were salted at Loring; these were simply received at the cannery for shipment.

It is impossible to give detailed weights of fish from each stream. The averages to the case are the general averages of all of each species coming to the cannery. The redfish from Naha Stream weigh about the same as from Quadra, 8 pounds; Karta Bay, 7 pounds; Kasaan, 5 pounds. The fish from Moira Sound average 6½ pounds, except the Peter Johnson fish, which run from 3½ to 4 pounds. The average weight of the cohoes packed here also varies slightly from year to year, depending somewhat upon the localities from which the fish are received, the waste, and local consumption. These averages are derived by dividing the number of fish received by the cases packed; hence, if the waste or consumption is large, the average is raised.

The prices paid for redfish in 1896 were from $4 to $6.50 per 100, for cohoes $6 per 100, and for humpbacks from 50 to 75 cents per 100. As the average weight of fish from each stream is fairly well known, the price from the different streams is agreed upon at the beginning of the season. For instance, the fish from the Peter Johnson Stream being small, less is paid for them than for those from Karta Bay. The prices in 1897 ranged from $4.50 to $8 per 100, depending upon delivery at the cannery or at the fishery, amount of gear furnished by the cannery, and size of fish. The higher rate, $8, was paid where the competition was close, and in one place the rate was raised to $10. Cohoes commanded about the same price, and humpbacks from $6 to $7.50 per 1,000. Where a large number of these fish could be guaranteed and no gear was furnished, the latter price was paid under contract.

The cannery fishermen's contract was $45 per month and board from the time of leaving San Francisco until the return of the vessel.

The contract price with the Chinese was 40 cents per case for packing.

In 1896 the cannery employed, or bought fish from, 50 white and 75 native fishermen. In the cannery proper were employed 130 Chinese, 6 whites, and 15 to 20 native women ("klootchmen") to assist the Chinese during the busy season.

In 1897, 20 white and 175 native fishermen were employed, and the cannery help consisted of 7 whites, 25 native women, and 130 Chinese.

The cannery has 2 steamers. The *Arctic*, of 21 tons, with a crew of 5, is valued at $12,000. The *Novelty*, of 34 tons, with a crew of 5, is worth $12,000. Attached to the cannery is the bark *Electra*, of 940 net tons, and valued at $12,000. This vessel

carries the hands and the cannery outfit for the season from San Francisco in the spring. It is met at Dixon Entrance by one of the steamers and towed to the cannery, where it is tied up to the wharf for the summer. When the pack is finished the bark carries the hands back, and also the pack, or so much of it as can be handled. The crew of the *Electra* are fishermen and are so employed after the vessel reaches her destination, the officers taking charge of the cannery steamers, acting as watchmen, etc. In 1897 an extra vessel, the *Nicholas Thayer*, of 556 net tons and valued at $10,000, made two trips to assist in carrying the pack.

On the fishing-grounds and at the cannery are 29 lighters and fish-scows valued at from $50 to $100 each, and 21 seine boats valued at $50 each.

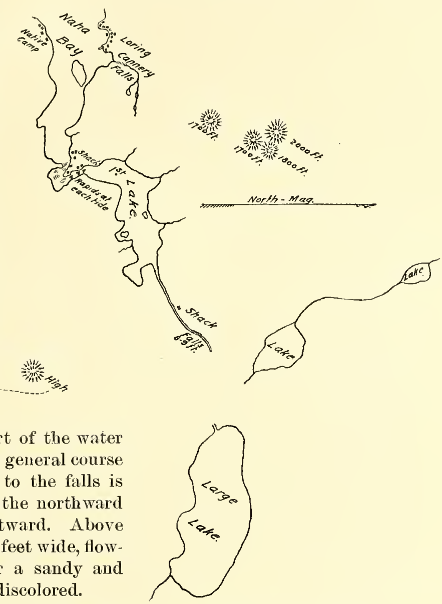
In 1896 the fish were all taken in 21 drag seines, varying in length from 75 to 250 fathoms, and valued at $1.50 per fathom. The seines were practically the same in 1897, though of the 21 only 7 were used by the cannery fishermen, as follows: Three, 150 fathoms long, 200 meshes deep; one, 125 fathoms long, 200 meshes deep; two, 100 fathoms long, 130 meshes deep; one, 75 fathoms long, 200 meshes deep. The others were used on the independent fisheries supplying the cannery. It is difficult to give accurate statistics of seines, not only on account of the independent fisheries supplying the canneries, but because every cannery has usually a number in reserve and a large amount of web, floats, etc., ready to be made up. The standard mesh for the Alaska fisheries is 3-inch stretched, and this usually takes the form of 2½-inch in the bunt, 3-inch in the quarters, and 3½ to 4 inch in the wings.

NAHA STREAM.

Upon arrival at Loring inquiry was made at once in reference to this stream and its lake system. The only information obtainable was that the stream was of considerable length, flowing through a very rough and rugged country, and was the outlet to a chain of lakes, some reports said two, others as high as seven. No one could be found, however, who had explored the region or who could give definite information. It was decided that an examination of the lower course of the stream and a view of the lake basin from a mountain top was all that could be attempted. Accordingly, a party ascended a mountain a little over 1,700 feet high, back of the cannery, and took photographs and bearings of the lake basin, estimating distances of prominent features. It is probable that all these lakes indicated on the sketch communicate with each other or with the outlet.

Upon leaving the cannery for the stream, a small wooded island, connected with the shore at low water, is passed, and continuing to the eastward about a mile the head of the bay is reached. The bay here narrows to a passageway (which turns about 180° to the northward around a sharp projecting point) connecting the head of the bay with the first lake or lagoon. On the inner side of this passage, and on the western shore, is an old saltery, now used for storing boats and fishing gear. The bottom of this passage is rocky, and rises in such a manner that on both tides it forms rapids, making slack water only when the tide is within about 2 feet of ordinary high water, so that the current usually flows out. This body of water may be termed the "first lake." The water was found practically fresh at all stages of the tide. The water that flows in during the last of the flood can only be slightly brackish, for the large discharge keeps the water brackish in the upper part of the bay, and the amount that flows in forms only an inconsiderable portion.

This lake is about a mile long by one-fourth of a mile wide, with a depth of from 6 to 18 fathoms, with a muddy bottom. The banks around the western and southern shores are rocky. On the northern shore three small draining streams, only a few feet in width, enter. They run from the mountain for about one-fourth of a mile to the lake over a comparatively level bottom of sand and gravel. They flow into bights where it is marshy or grassy, and at this point the lake is shallow along the shore, with mud and sandy bottom. A large stream enters the southern side near the eastern end, where there is a large grassy flat. At the eastern end, near the northern shore, is the mouth of Naha Stream, the outlet of the interior lake system. Around the mouth is a grassy flat, and off it the water is rather shallow, with a sand and gravel bottom. It is a beautiful stream at this point, about 200 feet wide and 2 feet deep. It preserves its width for about half a mile, when the banks contract, forcing the water between two rocky points about 40 feet apart, and 200 feet above this point are falls about 75 feet wide and 8 feet high. Half the height is a cascade; the rest is a straight fall on one side, while upon the other it is partly broken. The greater part of the water flows over the straight fall. The general course of the stream from the mouth to the falls is east-northeast, turning more to the northward at the falls, and then to the eastward. Above the falls the stream is about 125 feet wide, flowing between rocky banks over a sandy and gravelly bottom. The water is discolored.



Naha Bay and Lakes.

This salmon stream, one of the best in southeast Alaska, has suffered through the use of barricades. Until 1893 it was so solidly closed that it did not seem possible for a fish to pass through. That year the barricade was removed, and the stream has remained open ever since. Whether the stream was ever barricaded at the mouth of the outlet, near the eastern end of the lake, could not be ascertained. The barricade of 1893 and the earlier ones were placed at the head of the bay, where it contracts. A trap had been driven here almost entirely across the bay, but as few fish were taken more piles were driven, and, it is said, a close-mesh net was stretched across the stream so effectually that not a salmon could pass.

Fishing is carried on entirely with drag seines, one crew fishing in Naha Bay below the tidal rapids, and another in the first lake above the rapids.

The following shows the statistics of Naha Stream from 1887 to date. While the record is not very clear in some seasons, in the main it is correct:

Year.	Species.	Dates.	No.
1887..	Redfish ...	Not given	74, 483
1888..	Redfish...	June (first on 18th, 50) ...	2, 153
		July	42, 833
		August (no record, but taken from totals).	30, 218
		Total	75, 204

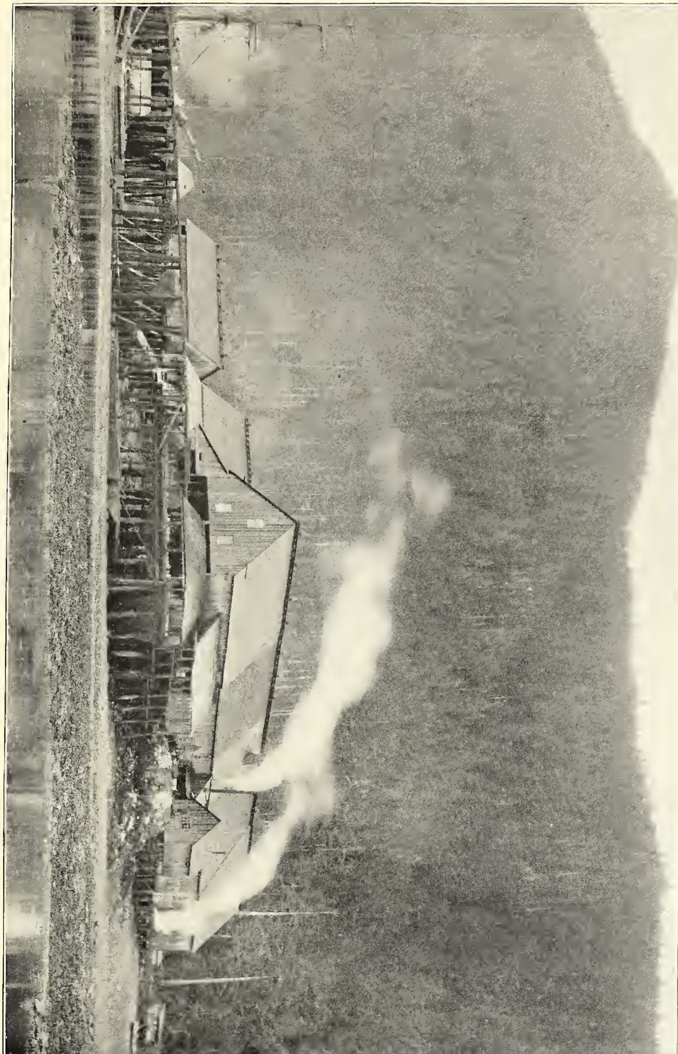
This cannery was first operated in 1888. The above fish made 8,366 cases, averaging 9 to the case. Cases of cohoes not given. The stream also furnished 99,200 humpbacks, making 6,200 cases, 16 to the case; and 67,500 more humpbacks were salted, making 900 barrels, of 75 to the barrel. Judging from the records, the pack in 1888 was made entirely from the home stream and Karta Bay fish.

Year.	Species.	Dates.	No.
1889..	Redfish ...	June (first on 22d, 850) ..	3, 902
	Do....	July	35, 202
	Do....	August, to 20th	36, 730
		Total	75, 834
1890..	Redfish ...	June (first on 20th, 1,550).	10, 921
	Do....	July	53, 231
	Do....	August, to 28th	3, 507
		Total	67, 659
	Cohoes....	Aug. 28 to Sept. 12	4, 827
1891..	Redfish ...	June (first on 14th, 49) ...	8, 494
	Do....	July	69, 551
	Do....	August, to 27th	18, 351
		Total	* 96, 396
	Cohoes....	Aug. 20 to Sept. 11	* 3, 013
	Humpback	One taken June 30.	
1892..	Redfish	June (first on 16th, 18) ..	52
	Do......	July	19, 585
	Do......	August, to 18th	2, 779
		Total	† 22, 416
	Cohoes......	Aug. 25 to Sept. 9	4, 495
1893..	Redfish	June (first on 23d, 350)...	1, 532
	Do......	July	41, 154
	Do......	August, to 8th	3, 430
		Total	‡ 46, 116
1894..	Redfish	Approximate	56, 490
1895..	Redfish	June (first on 20th)	1, 347
	Do......	July	10, 136
	Do......	August, to 19th	3, 250
		Total	14, 733
	Humpbacks.	July (first on 19th)	14, 465
	Do......	August	326, 504
		Total	340, 969
1896..	Redfish.....	June (first on 19th)	621
	Do......	July	25, 011
	Do......	August, to 23d	18, 150
		Total	43, 782
	Humpbacks.	July (first on 18th)	51, 869
	Do......	August	309, 869
		Total	361, 738
1897..	Redfish.....	July 7 to Aug. 14	16, 000
	Humpbacks.	July 9 to Aug. 24	130, 000

* Paid for outside fish, 6 cents each for redfish, 9 cents for cohoes.
† Another record gives a total for this year of 46,326.
‡ Another record given for 1893 is 52,800.

The average number of redfish taken per year, according to the above figures, is 53,555. The best authorities consider the stream good at present, under fair conditions, for 50,000 redfish, 5,000 cohoes, and 400,000 humpbacks, and, if properly cared for, it should yield 75,000 redfish per year. The stream seems ideal for salmon, and if improved, even under natural conditions, the run of fish could be increased very materially. No observations could be made on the spawning habits. It is improbable, however, that any humpbacks go over the falls, all spawning below; but the redfish go over the falls into the lake system, and this makes the conditions favorable for keeping the humpbacks from disturbing the nests of the redfish. It is probable, however, that many redfish fail to get over the falls, and others that succeed are bruised and injured. A hatchery might be very successful not only at the falls, where there is an abundance of water and fish, but at Loring, where water could be supplied from a stream back of the cannery.

At Loring they expect a few red salmon from June 20 to July 1, and by the latter date to have the cannery started. Redfish are then packed until the end of August, the latter part of this time, however, only in a scattering way and in connection with the other species. A few cohoes are packed during the early part of August, and this is continued until the cannery closes, about September 20, though these fish are



CANNERY AT LORING.

never very abundant. The humpbacks commence coming to the cannery about the middle of July and are packed until the latter part of August. The dog salmon is very little used for canning. Sometimes a few find their way into humpback cans, but as a rule they are not used. A few hundred cases were packed at Loring in 1896, from July 17 to August 7, but none in 1897.

During the winter of 1896–97, from the latter part of December until April, Naha Bay was filled with small salmon from 6 to 10 inches in length. They were probably young king salmon, but they may have been redfish. They took the troll readily. No attempt was made at seining. A few were shipped fresh to Seattle, and a few others were salted for local use. They were full of spawn, but not ripe, and none entered the river. It is believed around Loring that 20,000 cases of these fish could have been packed.

YES (OR M'DONALD) BAY.

Yes (or McDonald) Bay is a narrow inlet opening into the western shore of Behm Canal, extending in a general northwest direction about 20 miles to the northward of Loring. Midway the length of the bay, on the northern shore, is the cannery of the Boston Fishing and Trading Company. The buildings are on the peninsula formed by the bay and the right bank of Yes Bay Stream.

In 1886 Rhode & Johnson located at Yes Bay and salted salmon. The following year the firm became Ford, Rhode & Johnson. Several thousand barrels were salted and part of the present cannery buildings were put up. In 1888 the cannery buildings were completed and several thousand barrels of salmon were salted. In 1889 the machinery was installed and a pack of between 4,000 and 5,000 cases made. The same year the Boston Fishing and Trading Company was incorporated, Ford & Rhode transferring their interests to that concern. The cannery is at present largely, if not entirely, owned, operated, and managed by Mr. D. W. Crowley, of Portland, Oregon. It is one of the smaller canneries of Alaska. While not equipped with all the latest appliances, it has packed between 20,000 and 25,000 cases per year for several years.

The following statement shows the pack for 1896 and 1897:

Species.	1896.			1897.		
	Date of packing.	No. of cases packed.	No. of fish per case.	Date of packing.	No. of cases packed.	No. of fish per case.
Redfish	July 11 to Aug. 25	7,000	9	July 12 to Sept. 4	6,754	9
Cohoes	Aug. 20 to Sept. 15	2,100	6	Aug. 16 to Sept. 12	1,644	6
Humpbacks	Aug. 5 to Sept. 5	15,000	16	July 12 to Sept. 6	12,806	15
Dog salmon				July 17 to Aug. 7	1,096	6
Total		24,100		Total	22,300	

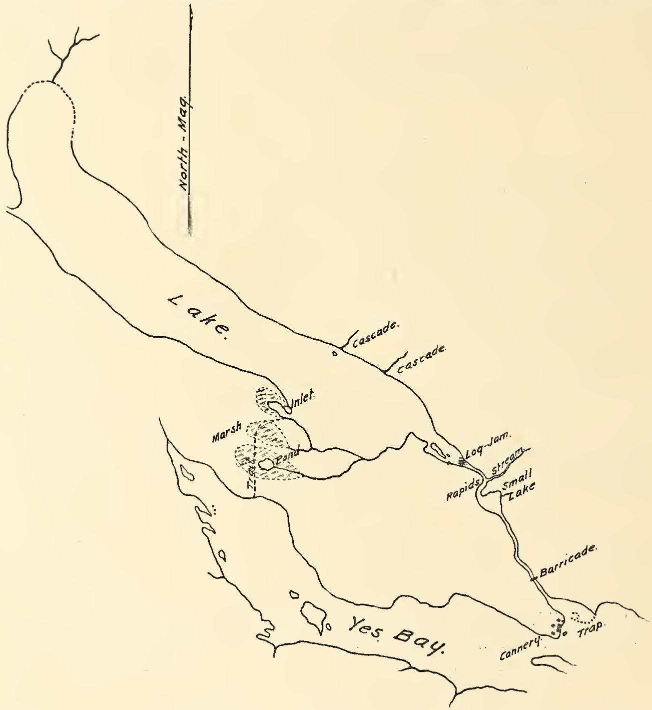
NOTE.—From July 12th to September 12th 3,037 cohoes were salted, making about 150 barrels.

In 1896 there were employed 15 white and 20 native fishermen, and in the cannery 3 whites, 50 Chinese, and, during the busy season, 10 "klootchmen." Four drag seines were used, 80 to 140 fathoms long, 3-inch mesh, valued at $1.50 per fathom, and 1 purse seine 320 fathoms long by 30 fathoms deep, 3-inch mesh, valued at $800.

One small steamer, the *Rosie*, of 5 tons, crew of 2, and valued at $2,000, tends the cannery. An additional steamer is sometimes chartered during the busy season. There were 6 lighters, or fish-scows, valued at from $50 to $75 each, and 4 seine boats, valued at from $50 to $75 each.

The cannery equipment in 1897 was the same as in 1896, except that in addition there was chartered the steamer *Alaska*, 38 net tons, crew 5, and valued at $5,000.

The redfish packed at this cannery come almost entirely from the home stream and Checats, the latter being also fished for the Loring cannery. They are of the larger variety, averaging about 9 to the case. Very few fish are bought. At Yes Bay the redfish run in sufficient numbers to permit the commencement of packing about the



Sketch of Yes Bay Stream and Lake.

middle of July. In 1894 packing was begun on July 17; in 1895 on July 14; in 1896 on July 11, and in 1897 on July 12. It is expected that the cannery can be operated for redfish from July 15 to August 25. At the time of our visit, July 2 and 3, salmon were seen jumping in the bay, stream, and lake, but the manager stated that a sufficient number had not come in to warrant operating the cannery before the time mentioned.

The humpbacks are from Stewart Bay, Hot Springs, Burroughs Bay, Stewart River, Gedney Pass, and other localities where they school. About 225,000 are used, only a few being taken in the home stream. Cohoes are found scattering in different localities.

Yes Bay Stream empties into the bay near the cannery. At the widening of the mouth, where it enters the bay, a pile trap occupies three-fourths of the width of the stream at high water. The census report of 1890 states that as many as 5,000 salmon are taken out of this trap in a day. The stream flows with a strong current, in a general southeast direction, over a rocky and bowldery bed for almost its entire length. It is about a mile long, from 40 to 60 feet wide, and from 2 to 5 feet deep, carrying a large volume of water.

About 200 yards above the mouth of the stream, at the head of tide water, a partly dismantled barrier was found, which could be made effective, thereby closing the stream in a few hours. This barricade is of similar construction to those already described, except that the rails are separated like the rafters of a house, and gratings, or Indian fences, were formerly secured over them, and over all a wire netting. Some of the wire nettings had been carried away, but could easily be replaced.

The stream is the outlet to a lake, and about $\frac{1}{4}$ mile below it widens to about 200 yards, forming a lakelet about 6 feet deep with sand and gravel bottom. Immediately below the outlet is a rapid 150 feet long, 40 feet wide, by $2\frac{1}{2}$ feet deep, and the stream, falling about 4 feet, spreads over granite bowlders to a width of 80 feet. A large stream with a delta enters at the rapids from the eastward. Above the outlet is a log jam, over which the lake can be crossed.

The lake lies in a general northwest-and-southeast direction, and is about 3 miles long by $\frac{3}{8}$ to $\frac{1}{2}$ mile wide. It is deep, especially along the northern side, where the mountains come to the edge. On the southern side are several shallow bights, in which marshy streams enter. A number of cascades were noted along the northern shore, two of them having grassy banks and gravelly beaches near the point of discharge. With these exceptions, the shores along this section are rocky and steep. The head was not visited, but it is reported that a large stream enters where the lake turns in between two mountain ranges. It is said that there is a second small lake connected with the main lake by a stream having a high fall, but no one could be found who had ever visited it. The main lake can be reached by trail from the bay, near the upper end, at a point about 2 miles from the cannery. The trail runs in a general northerly direction and is about half a mile long.

The following is the record of the Yes Bay fishery for a number of years. The figures for years prior to 1893 are not available.

Year.	Species.	Dates.	Total catch.	Year.	Species.	Dates.	No. of fish per case.	Total catch.
1893	Redfish		26,292	1897	Redfish	July 11 to Sept. 4	9	60,900
1894	do		21,541	1897	Cohoes	Aug. 11 to Sept. 14	6	9,511
1895	do		42,007	1897	Humpbacks	July 12 to Sept. 4	15	185,608
1896	do	July 11 to Aug. 25	46,706	1897	Dog salmon.	July 17 to Aug. 7	6	5,862

This stream has been barricaded for many years. It has a fine lake system, and under fair conditions should yield 50,000 redfish per year. It is said that some years ago as many as 70,000 were taken from it. The locality seems well adapted for a hatchery.

In 1896, from July 15 to 20, an Indian supplied the cannery with about 100 king salmon taken in gill nets in the vicinity of Burroughs Bay. They were all very large, some of them reaching 89 pounds in weight. The cannery commenced packing them, but as there were so many white-meated ones it declined to take any more. The

manager has under consideration the advisability of attempting a pack of king salmon. They can be taken and are in good condition as early as May 15, or as soon as the ice is clear of the bay.

CHECATS.

In Behm Canal, about 2 miles east of New Eddystone Rock, is an indentation or bay which receives a stream called Checats. This stream is said to have large red salmon and to be capable of yielding 10,000 a year.

The following figures were obtained, but no complete record was available:

Year.	Species.	Total number.	Average number per case.	Season of run.	Canneries to which consigned.
1895	Redfish	9,680			Yes Bay.
1896	Redfish	10,712		July 12 to Aug. 12	Yes Bay and Loring.
1897	Redfish	15,229	9	July 10 to Aug. 28	Do.
	Cohoes	489	6	Aug. 26 to Sept. 1	Yes Bay.
	Humpbacks	20,682	15	July 21 to Aug. 15	Yes Bay and Loring.
	Dog salmon	821	6	July 23 to Aug. 2	Yes Bay.

There are many streams entering Behm Canal and its branches that should be examined, but, so far as known, no others that have many redfish.

BURROUGHS BAY.

At a point where Behm Canal turns at right angles to the southward, Burroughs Bay enters, and at its head is the Unuk River, one of the largest streams of southeast Alaska, and said to contain king salmon, redfish, and cohoes. On the eastern shore, near the head of the bay, was formerly a cannery known as the Cape Lees Packing Company. Mr. James Miller operated a saltery here in 1886 and 1887. In 1888 Messrs. Andrew and Benjamin Young, of Astoria, built the cannery and operated it in 1888, 1889, and 1890; it made no pack after the latter year. In 1892 the cannery joined the Alaska Packing Association, and in 1893 it became one of the canneries of the Alaska Packers' Association. In 1894 it was dismantled, part of the machinery going to Loring and part to Wrangell. Mr. Miller states that from 1,200 to 1,500 cases of king salmon could be packed at Burroughs Bay, but that the proportion of white meated fish is very large. He also stated that he had taken salmon there weighing 90 pounds.

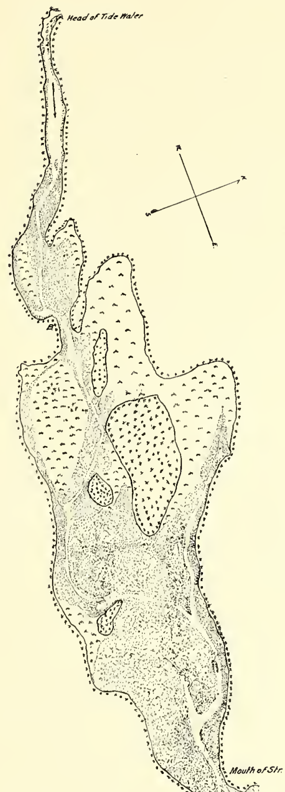
THORNE BAY.

Thorne Bay is an arm of Clarence Strait on the eastern side of Prince of Wales Island. Formerly all the waters to the westward of a line drawn from Tolstoi Point to Tolstoi Island were known as Tolstoi Bay. The chart has named the eastern bay "Tolstoi," and the western one "Thorne Bay," but the latter is still referred to as "Tolstoi," causing much confusion. In the bay named Tolstoi on Chart A there are no red salmon streams—in fact, no streams of any importance—while in Thorne Bay there is one very large stream, which empties into the head of the northwest arm, and differs entirely from any of the other streams thus far visited. It partakes more of the nature of a river, having a large estuary, and flows through a comparatively flat and level country, with the tide ascending a considerable distance. It is an outlet of a lake whose source is said to be from 12 to 15 miles from the mouth. No white man in the vicinity has ever visited it, and all that is known of it is from information given by an old Indian who hunts there during the winter. It is said there is a chain of

FLAT ALONG THORNE BAY STREAM.

lakes at the head, and that several tributaries to the river have lake sources. As it would have taken several weeks to thoroughly explore the locality, only the lower course of the stream was examined.

From the mouth of the stream to the head of tide water is a distance of about 2½ miles. At low water the stream runs a winding course through uncovered flats and grassy banks, at places separating into several channels or sloughs, while at high water these flats and banks are all covered, and it has the appearance of a large bay 2 miles long in a general east-and-west direction, with a greatest width of five-eighths of a mile, with wooded islets (one three-eighths of a mile long) and heavily wooded banks. The mouth is contracted to a width of about one-eighth of a mile, the flats extending into the outer bay some distance outside of the natural banks. These flats afford excellent seining ground at low water. At the head of tide water, where the stream flows between rocky banks, it is contracted to a width of 45 feet, expanding as it proceeds toward the sea to 120 feet, and about three-eighths of a mile down it opens out to 300 yards, contracting again about one-eighth of a mile beyond, and then opening into the large high-water bay. At this point is a small wing of rocks and rails and the remnant of a wire net, which probably formed at one time a barricade. The depth here at high water would be about 7 feet. There are no indications that the stream has been barricaded in recent years.



Sketch of stream at head of Thorne Bay, taken at low water. From mouth to head tide water. High-water mark in heavy lines.

The bottom over the flat generally consists of gravel and sand; in the narrower part it is rocky, and above tide level becomes more so, though for about a quarter of a mile above it runs through bottom lands between wide, high gravel banks, heavily wooded and in some places grassy. The fall of the main stream is slight, and occasionally there are deep pools. At the time of our visit the main stream, above the influence of the tide, had an average depth of 18 inches over a riffle 75 feet wide. Half a mile below the high-water mark the stream becomes brackish, increasing in salinity toward the mouth; yet it is said that humpbacks spawn all over these tidal flats, and

frequently, as the tide falls, the eggs are exposed to the sun, and the sea birds feed upon them. The shoals and flats at the mouth of the stream barely admit a boat at low water, but at high water one may go up the stream as far as tide water extends.

About 1888 a saltery was established on the northern shore of the entering arm at Thorne Bay. The following year it was sold to the cannery at Loring, then operated by the Cutting Packing Company, of San Francisco. In 1892 this saltery was sold to Mr. Robert Bell, who moved it to its present site and abandoned the old station. Two or three Indian houses are all that now remain at that point. The saltery at present is located on the upper end of the northwest arm, on the western shore, at the extreme end of the river flats, and is not only close to the fishing-grounds, but is on one of the best harbors in southeast Alaska. The saltery building is over the wharf, and back of it are several dwellings. The owner lives there.

No fish were salted for the first two years after the saltery was moved; all were carried to Loring and sold fresh for packing. The plant, without fishing gear, is valued at $1,500. Eight men are employed for 2½ months during the fishing season, and 20 men for one month during the time of the heaviest runs. Two drag seines are used, 3-inch mesh, 125 fathoms long by 5 fathoms deep, valued at $1.50 per fathom. Four seine boats, valued at $50 each, are employed.

The following incomplete statistics give all the obtainable record of Thorne Bay stream:

Year.	Species.	Number taken.	Time of fishing.	Remarks.
1889..	Redfish	10,790	July 6 to Aug. 17	385 taken on July 6.
1890..	Redfish and cohoes	52,516	July 10 to Sept. 10	Species not separated; probably one-third were cohoes. Large redfish brought 10 cents, small redfish 6 cents, cohoes 14 cents, delivered at cannery.
1891..	Redfish	14,456	June 28 to Aug. 1	3,400 taken on June 28.
	Cohoes	11,698	Aug. 17 to Sept. 1	2,760 used at Loring cannery, the remainder salted at Tolstoi fishery.
1896..	Redfish	5,000		Average weight, 5 pounds; salted, making 86 barrels, worth $6 to $8 per barrel net.
	Cohoes	25,000		9,000 sold to Loring, rest salted, making 450 barrels, worth $6.50 per barrel on Seattle wharf. Average weight of fish, 8 pounds.
	Humpbacks	80,000		25,000 sold at Loring, bellies of remainder salted, making 470 half-barrels, worth $4.50 per half-barrel net. Average weight of fish, 3½ pounds.

It was ascertained at Loring that 600 half-barrels of humpback bellies and 160 barrels of cohoes were salted in 1897. It was stated that the stream at present will yield annually 5,000 redfish, 25,000 cohoes, and 200,000 humpbacks; that it is a very early redfish stream, the first arrivals, from June 1 to 10, depending upon the season, and that the run usually ends about August 5. From the scanty records, it would seem that it will furnish perhaps 10,000 redfish, if fished by a cannery. After the redfish have commenced to run many are taken that seem very much out of condition. They are very thin and the intestines are found closely adhering to the body walls.

The stream is also known as having very early runs of cohoes, the first fish appearing about July 5, and the run continuing until September 13 to 25, but the fish are small; in fact, it is said that the cohoes of all the island streams are small, those from the streams on the mainland being much larger. The humpbacks here run from August 1 to September 1, the fish averaging larger during a big run than during a small one. The dog salmon run with the humpbacks, but are not used. Steelheads run from November to April, though scattering ones are taken every month in the

HEAD OF TIDEWATER, STREAM AT THORNE BAY.

year in various spawning conditions. Spent steelheads have frequently been taken on their return to the sea.

Trout are numerous in this stream, and not only here but everywhere in Alaska the cry is to exterminate them, or at least not to protect them by law, as they are regarded as the greatest enemies to the salmon, destroying the eggs in countless numbers. Dolly Varden trout are found running from June 10 to July 15, and follow the salmon to the spawning-beds. The cut-throat trout also come down to brackish water about the same time.

In 1895 three shad were taken in a trap in Thorne Bay, and it is believed that if traps were more extensively used shad would probably be taken in many different localities in southeast Alaska.

UNION BAY.

On the western side of Cleveland Peninsula, and opening into Ernest Sound, is Union Bay. In this locality is a small red-salmon stream fished by Mr. Myers, who sells the catch, with that of Kina, in Kasaan Bay, which he also fishes, to the Loring cannery.

The following records have been obtained:

1896.			1897.		
Species.	Dates.	Number.	Species.	Dates.	Number.
Redfish	July 16 to 31	3,258	Redfish	July 26 to Aug. 26	4,700
Do	Aug. 3 to 7	1,393	Cohoes	Sept. 1 to 20	2,250
Cohoes	Sept. 1 to 14	1,408	Humpbacks	July 26 to Aug. 26	9,874

WRANGELL.

In 1887 the Aberdeen Packing Company, of Astoria, Oreg., built a cannery on the Stikine River, about 8 miles above the mouth, with the intention of making the entire pack from the catch of this river. After packing two seasons, in the fall of 1888 and spring of 1889, the cannery was moved to Point Highfield, on the northern end of Wrangell Island, and operations commenced under the name of the Glacier Packing Company. In 1892 it entered the Alaska Packing Association and was closed, and in 1893 it joined the Alaska Packers' Association, and has since been operated by that organization. In 1896 it was enlarged, and now has a capacity of 1,500 cases per day. The cannery is located in a small bight to the eastward of and just inside of Point Highfield, about 1½ miles from Wrangell post-office, and 2 miles from the flats at the mouth of the Stikine River.

In 1896 the cannery employed 20 white fishermen, and received the catch of 70 natives. In the cannery were 8 whites, 4 native women, and 80 Chinese. The cannery fishermen used for king salmon 14 large gill nets, each 250 fathoms long, 24 meshes deep, 8½-inch mesh, valued at 40 cents per fathom; for redfish and cohoes, 14 small gill nets, each 200 fathoms long, 26 meshes deep, 6½-inch mesh, valued at 40 cents per fathom, and 9 drag seines, from 50 to 150 fathoms long, 3 to 8 fathoms deep, valued at $1.50 per fathom.

The vessels engaged were the steamer *Puritan*, 14 net tons, crew 5, value $10,500, and the steamer *Ella Rohlffs*, 37 net tons, crew 5, value $14,000. Usually but one of these tenders is used. The ship *Geo. Skolfield*, 1,276 tons net, value $16,000, with a crew of fishermen, was used as a transport. The same arrangement is made here as at Loring. The ship brings the outfit to the cannery in the spring and moors in the

stream; the crew then become fishermen, and the officers do duty in connection with the cannery. In the fall the ship carries the pack and outfit back. The cannery uses 2 lighters, one valued at $50, the other at $400; 14 Columbia River boats, valued at $180 each, and 20 skiffs, dories, etc., valued at $25 each.

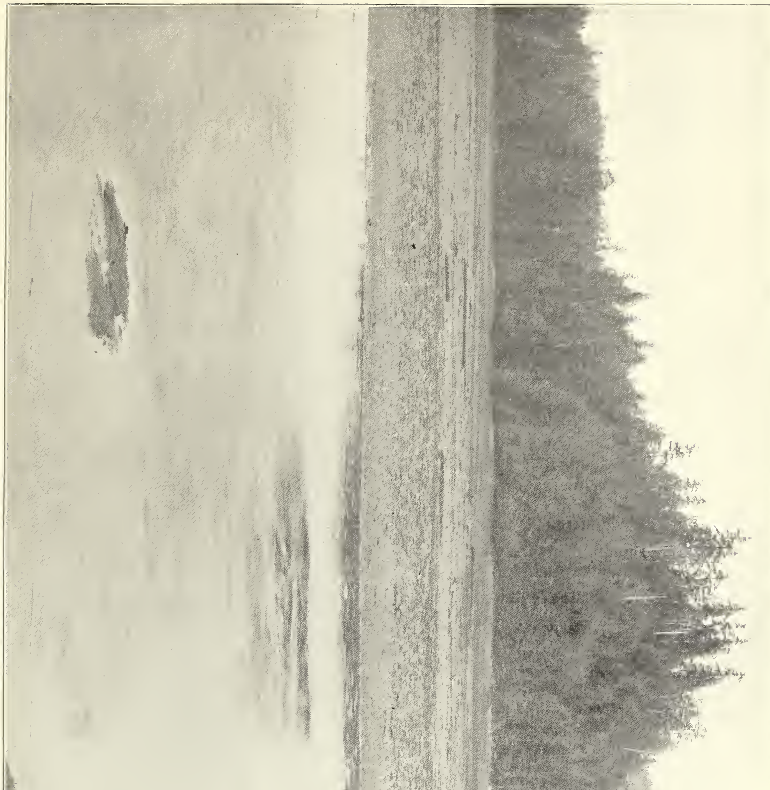
Cannery near Wrangell.

This cannery and that at Pyramid Harbor are the only ones in southeast Alaska that pack king salmon, and even at these places this fish forms a very small part of the pack.

The following gives the statistics of the pack for 1896:

Species.	Dates.	Number of fish.	Number of cases.	Number of fish per case.	Remarks.
	1896.				
King	May 15 to May 31	1,239			
	June 1 to June 22	2,719			
		3,958	987	4	All taken in gill nets around mouth of Stikine River. These fish would appear to average about 16 pounds, but the real average is said to be about 22 pounds. Of the total number, many are consumed at the factory and many others are not used because they are white-meated.
Redfish	June 22 to June 30	7,914			
	July 1 to August 31	115,623			
		123,537	12,584	9.88	About 30,000 taken around mouth of Stikine River; the rest in drag seines. Average weight rather under 7 pounds.
Cohoes	July (first on July 1)	23,064			
	August	32,403			
	September to 16th	31,653			
		87,120	11,010	8.3	30,000 taken in gill nets around mouth of Stikine River; the rest in drag seines. Average weight said to be about 11 pounds, but this is not consistent with figures given.
Humpbacks	July 1-31	68,770			
	August 1-29	291,505			
		360,275	19,652	18.4	All taken in drag seines.

 PLATE 41.



STREAM AT THORNE BAY.

In 1897 the cannery received and packed the following salmon, according to the cannery books:

Species.	Dates.	Total number of fish.	Number of cases.	Number of fish per case.	Remarks.
	1897.				
King	May 15 to June 25	4,946	1,246	3.9	All taken in gill nets at mouth of Stikine River.
Redfish	June 25 to Aug. 6	70,870	7,428	9.5	
Cohoes	July 7 to Sept. 15	76,153	8,620	8.8	
Humpbacks	July 12 to Aug. 18	662,563	28,624	23.1	

In 1896 and 1897 the cannery paid $5.50 per 100 for redfish and cohoes at the fisheries, and $7 per 100 delivered; and for humpbacks 50 cents per 100, the steamer calling for them. The run of redfish in 1897 was very small, but humpbacks were so plentiful that the canneries here, as elsewhere, did not have the facilities for handling the catch.

The fishing contract here differs from that at Loring on account of the gill-net fishing. The company pays each man $125 for his services in taking the transport vessel to the cannery and back to San Francisco, and for discharging and loading at the cannery. There are two men to a gill-net outfit. When fishing commences the cannery supplies the gear and pays 5 cents for king salmon and 2½ cents each for redfish and cohoes. The fishermen also receive their board and lodging. The Chinese contract price for packing is 40 cents per case.

The streams supplying the cannery at Wrangell are the following: Stikine River, Salmon Bay, Red Bay, Lake Bay, Whale Passage, Ratz Harbor, Old Village, Anan (Bradfield Canal), Kah-Sheets, Wrangell Narrows, and incidentally a few fish are received from Shipley Bay and Point Barrie.

STIKINE RIVER.

The Stikine River (see Chart A) is the largest in southeast Alaska, and is the only one that is navigable; but as yet it has no very important relation to the salmon fisheries. A small stern-wheel steamer of light draft makes occasional trips to the trading posts located on its upper waters. The Cassiar gold discovery, near its headwaters, gave it additional interest in 1875–1877, and it has been much talked of as a route to the upper Yukon. It is said to receive the waters of 300 glaciers. It discharges through a wide delta with numerous shallow channels and a current of from 3 to 4 miles an hour, but in the upper waters, where it rushes through the canyons, the velocity probably reaches 10 miles. The flats formed by the river silt close the passages to the northward between the islands and the mainland, except for small boats.

It is believed that the run of all species of salmon up this river is large, and, if they could be easily captured, several canneries might be supplied; but only gill-net fishing is feasible, and on account of the wide expanse of river mouth, the numerous snags and bowlders, and strong currents, this method is not very profitable, as the best salmon are obtained in Alaska for a cent a pound, and in some places for little more than a cent a fish. The fishing here is carried on around the flats at the mouth of the river, in the sloughs and channels where the current is not too strong. Usually the gill nets are anchored; sometimes they are drifted. The Wrangell cannery in a

good season expects to obtain from the Stikine from 4,000 to 8,000 king salmon, 30,000 redfish, and 30,000 cohoes. It is probable that few salmon go to the headwaters, but they enter the numerous lower tributaries.

Fishing for king salmon commences about May 15, or as much earlier as the ice may permit, and continues until the latter part of June, when the redfish begin to run; the fishing gear is then changed. It is the general belief in Alaska that king salmon will run only in the streams carrying glacial water. Of the king salmon taken here, about one in six has white meat, the same ratio being preserved throughout the fishing season.

The only available record for the Stikine is for 1897, and is as follows:

Species.	Dates.	Number.
King	May 15 to June 25	4,680
Redfish	June 25 to July 30	21,206
Cohoes	Aug. 15 to Sept. 15	19,722
Humpbacks	July 12 to Aug. 18	20,394

The limited time permitted the examination of only one stream fished for this cannery, Kah-Sheets, and the others are referred to briefly with such data as could be obtained. Red Bay, Salmon Bay, Lake Bay, and Whale Passage are localities claimed and fished by Mr. Thomas McCauley. Several years ago there was a saltery at each of these fisheries, but they are now consolidated into one, which is located on Whale Passage. The catch from the streams in these places is sold by contract to the Wrangell cannery.

PRINCE OF WALES ISLAND, NORTHEAST SIDE.

In this region are located Lake Bay, Whale Passage, Salmon Bay, Red Bay, and Ratz Harbor. Lake Bay is situated on the northeast side of Prince of Wales Island (see Chart A) on the passage inside of Stevenson Island. The approaches are all foul and the bay inaccessible for a large vessel. The stream is known as a coho stream, and the run is the earliest in southeast Alaska, but the fish are small. It is said to have a capacity of from 50,000 to 60,000 cohoes and 5,000 to 10,000 redfish. There are, however, no records for redfish.

The following records of cohoes from Lake Bay were obtained:

1896.		1897.	
Dates.	Number taken.	Dates.	Number taken.
July 1 to July 31	23,064	July 7 to July 31	8,353
In August	25,629	Aug. 2 to Aug. 31	21,589
Sept. 1 to Sept. 16	9,452	Sept. 2 to Sept. 12	17,642
Total	58,145	Total	47,584

Whale Passage is about 5 miles to the westward of Lake Bay. The stream, which is essentially a humpback stream, is in the northwest arm of the passage. The saltery, operated here by Mr. Thomas McCauley, utilizes the fish that can not be handled at Wrangell. The stream is said to have a capacity of 200,000 humpbacks and from 2,000 to 3,000 cohoes. 1,400 half-barrels of humpback bellies were salted in 1897.

WATERFALL IN STREAM AT DUNCAN CANAL ABOUT ONE MILE FROM MOUTH.

MOUTH OF STREAM, DUNCAN CANAL, SHOWING GRAVEL BEDS.

The following gives the only available data for Whale Passage:

Year.	Species.	Dates.	Number taken.
1896	Cohoes	Aug. 18 to Sept. 11	2,050
1897	Humpbacks	July 12 to Aug. 18	225,000

No record was kept of humpbacks in 1896, as the contract was "by the case," but the catch was made from August 1 to September 1. No record was made of cohoes in 1897.

Salmon Bay is on the northeast side of Prince of Wales Island, about 10 miles from Whale Passage. It is a small bay with a lake outlet in the northwest end. The stream has a capacity for 20,000 redfish.

Red Bay is about 6 miles westward of Salmon Bay. At its head, on the eastern side, is a redfish stream with a capacity of from 18,000 to 24,000 fish.

The following are the available records of Salmon Bay and Red Bay:

Year.	Salmon Bay.			Red Bay.		
	Species.	Dates.	No. of fish.	Species.	Dates.	No. of fish.
1896	Redfish	July 1 to 30	19,725	Redfish	July 18 to July 31	16,348
1896	Cohoes	Aug. 1 to 31	2,682	Do	Aug. 1 to Sept. 1	4,542
1897	Redfish	July 1 to 15	15,012	Do	July 7 to July 29	12,004

Ratz Harbor is situated on the northeast shore of Prince of Wales Island, about 15 miles north of Tolstoi. At the northwest end of the harbor a stream enters, which is reported to yield 60,000 humpbacks, and is fished by the Wrangell cannery when the supply of humpbacks from streams nearer their route is short. There are no records for this stream.

OLD VILLAGE.

In the southern part of Zimovia Strait, about 6 miles below Deserted Village, is a rocky bay making into Wrangell Island. At the head of this bay is a stream, having a capacity of from 15,000 to 20,000 redfish, fished by Wrangell cannery.

The statistics for 1897 are as follows:

Species.	Dates.	No.
Redfish	June 28 to 30	907
	July 3 to 27	13,181
	Aug. 1 to 6	3,050
Cohoes	Aug. 6 to 31	1,992
Humpbacks	July 12 to Aug. 18	42,169

ANAN, BRADFIELD CANAL.

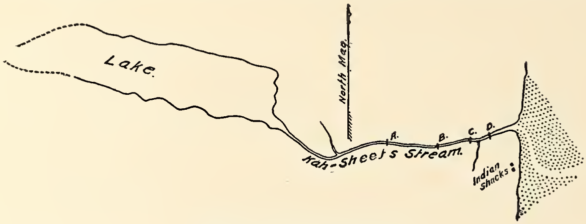
At the entrance to Bradfield Canal, on the southern shore, in the angle formed by the shore line running first east from Point Wards and then north, is a stream which is fished by the Wrangell cannery, and which supplies a large number of humpbacks. The fish commence to run in the first part of July, and the stream is reported good for 300,000. In 1897 the Wrangell cannery obtained 375,000 humpbacks between July 12 and August 18.

WRANGELL NARROWS.

Opposite Finger Point is a small stream which supplies, under ordinary conditions, 2,000 redfish. In the northern end, in the bight opposite Turn Point, is a stream which supplied Wrangell cannery in 1897, from August 18 to September 1, with 4,904 cohoes. This is also a good humpback stream.

KAH-SHEETS.

At the entrance to Duncan Canal, on the western shore, in the upper end of the bowldery bay inside of Lung Island, a redfish stream was examined. Its mouth is north of a narrow tongue of land making to the eastward and to the northward of a house occupied by a number of Indians. The stream is a lake outlet, about 3 miles long in a general east-and-west direction, and 60 to 70 feet between banks, but at the time of our visit the flow was only about 20 feet wide and 6 inches deep. The bed is



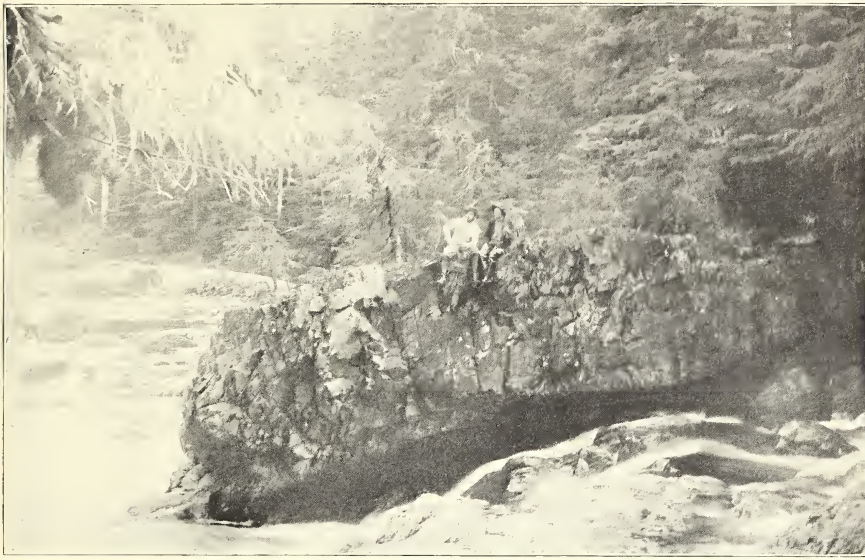
Sketch of Kah-Sheets Stream.

generally rock and coarse gravel. At four different places the stream drops in falls and cascades. The lake appeared to be from 3 miles to 6 miles long by ¾ mile wide, and is deep toward the center. The bottom, near the outlet, is mud and sand, and gravelly in a few places near the shore. This stream has a capacity of about 5,000 redfish. In 1897 it supplied the cannery at Wrangell as follows:

Species.	Dates.	No.
Redfish	July 3 to 28	3,502
	Aug. 1 to 3	616
Cohoes	Aug. 14 to 28	1,951

POINT BARRIE.

Point Barrie is the southwest point of Kupreanof Island, and in this vicinity is a stream said to have a capacity of 10,000 redfish. A small saltery is located here, and is operated with the fishery by Cyrus Orr. All the fish are sold fresh that can be disposed of in that way, but it is out of the track of cannery steamers. Occasionally a few are sent to Wrangell on the small mail steamer. In 1897 Wrangell received 692 redfish in that way. In 1890, when the census was taken, there was a small Indian village here and a store. Population, 89 Indians and 3 whites. The Baranoff Packing Company, of Redfish Bay, received from Point Barrie 4,467 redfish between July 9 and 20, 1892.



KAH-SHEETS STREAM.

STREAM AT LORING.

SHIPLEY BAY.

Shipley Bay is on the western side of Prince of Wales Island, and at its head has a stream which is said to yield 12,000 redfish annually. A small saltery on the bay is operated by Walter Kosmikoff, together with the fishery. This stream, like that at Point Barrie, is out of the track of cannery steamers, and a few salmon and salmon trout are salted and a few sold fresh. In 1897 the Wrangell cannery received 700 redfish from this fishery by mail steamer. The Redfish Bay cannery, in 1892, from July 9 to 20, took 6,762 redfish, and in 1893, from July 8 to 30, 5,295 redfish from this stream. These are the only records obtainable.

All these streams supplying the Wrangell cannery should be further examined.

ETOLIN ISLAND.

In 1892 Mr. J. C. Callbreath established a salmon hatchery on a small stream that never was known to run many redfish. It flows into the head of McHenry Inlet, on the western side of Etolin Island. The hatchery was built and is operated with the belief that salmon return to the parent stream. Mr. Callbreath has given the subject of Alaska salmon much study. He believes that artificial propagation will increase the run of this stream to such an extent that they can be taken in large numbers and sold with profit to the canneries.

KLAWAK.

Klawak is on the western side of Prince of Wales Island, near the head of an inlet of the same name, which is an arm of Bucarelli Bay. It is off the regular line of travel, but is on the mail route between Wrangell and Howkan, and once a month a small mail steamer calls at the post-office here. The oldest cannery in Alaska is in operation at Klawak, and in connection with it a steam sawmill and store. During the summer the settlement has a population of 300, of which number 275 are Indians and the rest white and mixed. There are about 50 houses in the vicinity, and also a school maintained by the Government. The cannery is one of two that have always been operated by Indian labor, and it is this enterprise that has made the village. The Indians employed are Haidas from the south, and Henegas (Thlinget) from the north and vicinity. The village is practically deserted during the winter, except by the cannery watchman and the storekeeper, the Indians going to their winter villages.

A saltery was operated at the place now known as Klawak until 1878, when it was purchased, with all its rights, etc., for $5,000 by the North Pacific Trading and Packing Company, and the present cannery was built that year. This was the pioneer in the salmon-packing business in Alaska and now enjoys the distinction of being the oldest cannery in operation, and of having made a pack every year since it was started. It has a capacity of 400 cases per day, but it has been worked to 700 cases when occasion demanded. The plant differs somewhat from those recently installed, in that less machinery is used and the pack is largely made by hand. The cutting, filling, and capping are all done by hand, and the cookers are old-fashioned, with dome-shaped or cylindrical covers that are raised by tackle to admit the trays, and then lowered and clamped. The plant, however, is very complete; the buildings are large and well-aired, there is plenty of room, the wharves are in good condition, and everything is thoroughly clean. It is said that the pack made here is second to none in the market.

The cannery at Klawak is one of the smaller canneries of Alaska. It packs from 12,000 to 16,000 cases, the fish being obtained from the streams north and south of the cannery. The field was clear until 1896, when the cannery at Hunter Bay was built, and since that time the fishermen of the two canneries resort to the same streams on the south end of Prince of Wales Island. Ten years ago the Klawak cannery received fish from as far south as Hessa, and even from Nichols Bay, but in late years the principal sources of supply of redfish have been Hetta, the home stream, and Sar-Kar, with small intervening streams that some years have furnished from 1,000 to 2,000 redfish. Cohoes are nowhere very abundant in this district during the canning season, though the Indians say that large schools frequently come in after the cannery people leave. The Indian's idea of a large number, however, is usually measured by his own wants. He has no conception of a large number with reference to a cannery supply.

The Hetta stream has already been described.

The steam sawmill connected with the cannery has a capacity of 15,000 feet per day, but is only used for making boxes and supplying local demands.

The work at Klawak, from the taking of the fish in the streams to the loading of the cases containing the canned product on board the ocean carriers, is nearly all done by Indians—men, women, and children. From the earliest operations of the cannery until 1896 Indian labor has been exclusively employed, but in that year two Chinese were engaged, one for cap-cutting and the other for final testing and as general expert. In 1897 seven Chinese were employed, and the manager had under consideration the feasibility of using Chinese and doing away with Indian labor, chiefly upon the ground of economy, but also because Chinese labor is more certain and more easily controlled. If, at the beginning of or during a season, the cannery should decline to accede to the demands of the Indians for increased wages, a strike is apt to result, causing the loss of a pack.

In 1896 the cannery employed 2 white and 40 native fishermen; and in the cannery the help consisted of 7 whites, 32 klootchmen, 30 men and boys, and 2 Chinese. There were used 4 seines, each 110 fathoms long, and valued at $300 each. The steamer *Klawack*, of 11 tons, with a crew of 4, and valued at $5,000, and the steamer *Cora*, with a crew of 3, and valued at $1,000, were the vessels employed; but in spring and fall a vessel was chartered as a transport. One fish-scow valued at $100, and 4 seine-boats valued at $90 each, were also used.

The following table gives the packs for 1896 and 1897:

Species.	Dates.	Number of cases packed.	Number of fish per case.	Remarks.
	1896.			
Redfish	July 19 to Aug. 23	14,089	13	40 barrels of salmon bellies were salted, 300 cases of clams were packed (24 two-pound cans to the case), also 300 cases of clam juice (24 one-pint cans per case).
Cohoes	Aug. 15 to Sept. 25	2,073	8 to 9	
Humpbacks	July 24 to Aug. 10	513	22	
	1897.			
Redfish	June 26 to Aug. 31	9,520	13	200 cases of clams and 200 cases of clam juice were also packed.
Cohoes	Aug. 18 to Sept. 20	1,995	8	
Humpbacks	July 26 to Aug. 22	4,190	22	

The sawmill and its machinery are valued at $13,000. The machinery also furnishes the motive power for the cannery. The cannery buildings, complete with storehouse, wharves, tramways, machinery, tools, fixtures, retorts, etc., are valued at a

HATCHERY AT KLAWAK

CANNERY AT KLAWAK.

little under $20,000. The whole property, including all the above, cannery and saw-mill, buildings, dwellings, wharves, tools, fixtures, and machinery, steamers, boats, seines, etc., but exclusive of material on hand, is valued at about $50,000.

When salmon were being packed it was noticed that the butchers on the fish float threw all the heads into canoes waiting alongside to receive them, and many canoe loads were carried away. Upon inquiry it was learned that the heads are put in baskets or bags placed along the shores between the high and low water marks, weighted with stones to keep them in place, and left for a week or ten days until thoroughly ripe; the snout or nose is then cut off and consumed by the Indians as a great delicacy.

PACKING CLAMS AT KLAWAK.

The clams in this vicinity are very abundant, and in the late summer and fall they are in excellent condition for packing, being full-flavored and white. In the spring they are very dark. The cannery each fall makes a small pack of a few hundred cases when the run of salmon grows slack, and the plant is idle several days at a time for want of fish. Owing to the great range of tide in Alaska and the great differences in the range, clams can only be obtained in quantities for a few days during the spring tides, so that if there were a large demand for them the pack would have to be incidental to the salmon pack or to some other industry to make it pay. So far, however, there has been very little demand for this product; the company has been unable to introduce it in competition with eastern goods. The clams are delicious, and the juice as prepared is pure and unadulterated except by the steam in cooking.

The Klawak cannery usually takes a few days in September for the clam pack, and prior to that time it notifies the Indians that clams will be purchased. Ten cents a bucketful is paid, the bucket holding about a peck. The wharf is first thoroughly cleansed and the clams are spread in one layer over it. A stream of salt water is then directed over them from a steam pump until they are perfectly clean. The clams are next put in a large perforated cylinder or tub holding about 8 bushels, and this rests on iron crosspieces placed over the upper end of a tight metal tub, which is a little larger in diameter and about one-third the height of the vessel in which the clams are placed. The whole is so arranged that in cooking, when the steam passes through the perforated tub holding the clams, the juice will fall into the lower tub. The tubs are made cylindrical in order to fit the retorts used here. The clams are then placed in the retorts, cooked under pressure at a temperature of 220° F. for twenty minutes, and then removed and placed on long, slatted tables, around which are seated "klootchmen," who remove the meat and cut off the black siphon or snout. The meat is carried to another table, cleansed by being passed through hot salt-water, and then packed into 2-pound cans. When the can is filled to the top with meat, hot juice is poured in, completely filling all the spaces, and the cans then go the solderer, by whom they are sealed.

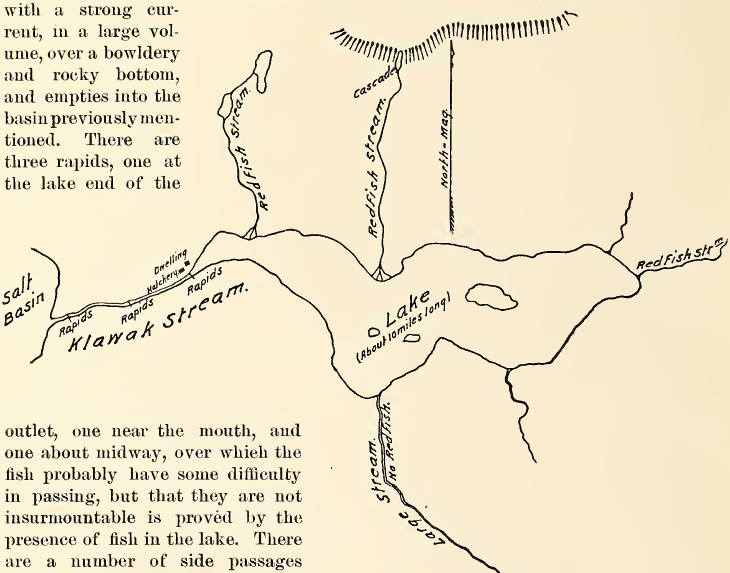
The juice, when removed from the retorts, is put into a barrel, and what is not used for filling up the cans of clams is poured into separate tins, each holding a pint. One-pound salmon cans are used for the juice, with caps having a small aperture to admit of soldering. After the cans are sealed they are tested, cooked, vented, sealed, cooked, tested, cooled, lacquered, tested, labeled, and cased. The day the cannery was visited 1,092 buckets of clams were packed, making 224 cases of 24 two-pound tins of clams and 190 cases of 24 one-pint tins of juice.

The Indians do all the work. They are neat, clean, and tidy, perform their work deftly, and receive $1 per day. It is extra work and not paid for by the piece. Before work was commenced about forty klootchmen presented themselves for employment, and from this number the manager made his selection.

KLAWAK STREAM.

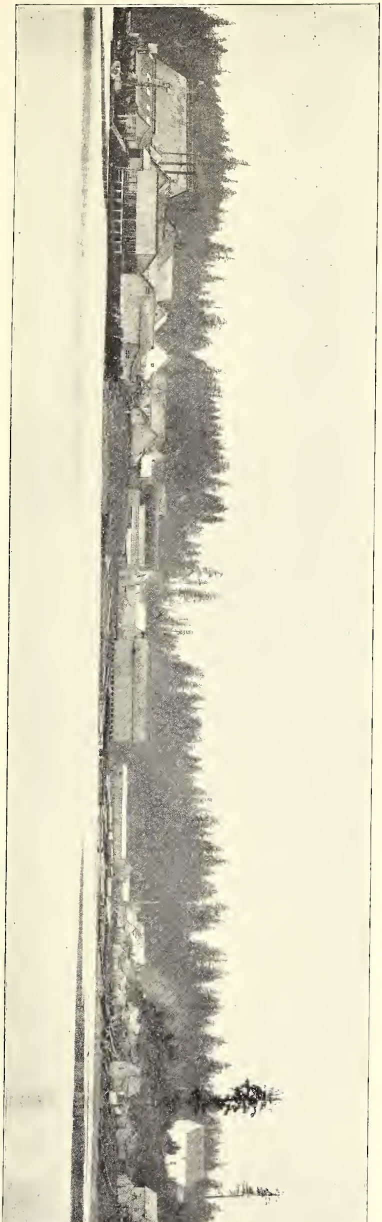
Near the upper end of Klawak Inlet is a large island, close to the eastern shore, and around the northern end of this island is a narrow channel leading to the cannery, which, with the village, is on the southern end of a head making out from the main shore of Prince of Wales Island. A narrow passage around the cannery leads back of the buildings to a salt-water basin less than half a mile in diameter. This basin receives the waters of the home stream.

Klawak Stream is a lake outlet and from the lake it flows in a general west-southwest direction for 2½ miles, with an average width of fully 100 feet. It flows with a strong current, in a large volume, over a bowldery and rocky bottom, and empties into the basin previously mentioned. There are three rapids, one at the lake end of the outlet, one near the mouth, and one about midway, over which the fish probably have some difficulty in passing, but that they are not insurmountable is provéd by the presence of fish in the lake. There are a number of side passages and pools in the stream, in which humpbacks and dog salmon spawn. The cannery company is considering either placing fish-ladders at the most difficult points of the stream or blasting out some of the ledges.

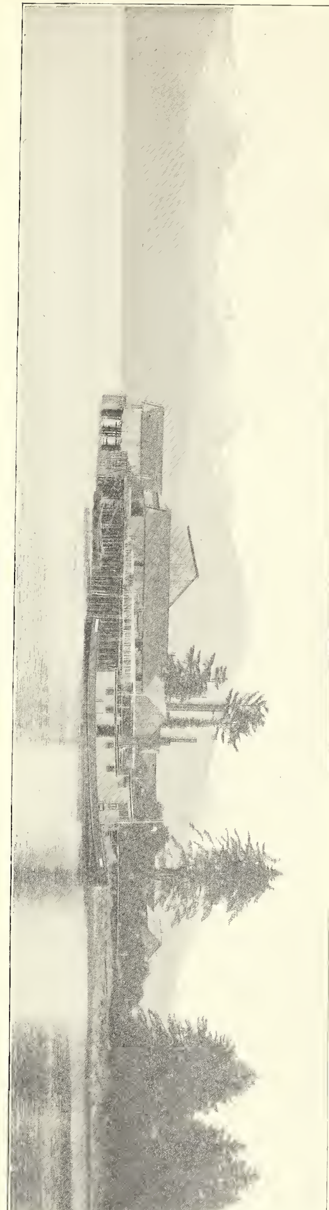


Sketch of Klawak Stream and Lake.

The lake is an irregular-shaped, elongated body of water, about 10 miles long in a general west-northwest and east-southeast direction, and from 1 to 2 miles in width. The shores, except for a short distance around the upper end, are low and flat and



VIEW OF KLAWAK, LOOKING WEST.



CANNERY NEAR WRANGELL.

extend back for a considerable distance before reaching the slopes rising to the higher ranges. This flat country is heavily wooded and along the shores are a number of gravelly beaches. The lake is fed by four large streams and several smaller ones. One on the northern shore half a mile from the outlet, one about 3 miles from the outlet on the same shore, and one at the head of the lake are all spawning-grounds for redfish. The largest stream enters the lake on the southern shore about 3 miles from the outlet, but red salmon do not spawn there. It drains a very low, flat area.

Klawak Stream has probably been fished longer and more assiduously than any other stream of Alaska. The cannery has been operated twenty seasons and a large number of fish taken from around the mouth of the stream at the cannery door. The natural facilities for taking the fish are very great, as they enter a natural trap in the basin back of the cannery and school around the mouth of the stream. The stream was barricaded and had an Indian trap in it for years, but as it was becoming depleted all traps and barricades were removed some years ago, and now the stream is carefully guarded and less extensively fished, in the hope of building up the run. There are now no signs of artificial barriers anywhere.

It is said that in the early days 80,000 redfish could be taken annually in the stream. The record for the past twelve years gives an average of 36,271, the largest catch being 62,602 in 1888. In 1896, a good redfish year, 37,172 were taken, and in 1897, a poor year, 12,764. A few steelheads are taken by the Indians. The stream at present is undoubtedly good for 35,000 redfish, and probably 40,000 under good conditions. It is believed that if properly cared for it could produce 80,000 redfish annually.

The following is the record of the stream since 1886:

Species.	Year.	Dates.	Number.	Species.	Year.	Dates.	Number.
Redfish	1886	July 21 to Aug. 20	5,424	Redfish	1892	June 24 to Aug. 17	40,555
Do	1887	June 27 to Aug. 15	41,180	Do	1893	June 22 to Aug. 31	33,166
Do	1888	June 27 to Aug. 22	62,602	Do	1894	June 21 to Aug. 15	34,722
Do	1889	July 1 to Aug. 13	19,361	Do	1895	June 23 to Aug. 14	40,526
Humpbacks	1889	July 22 to Aug. 13	92,094	Do	1896	June 29 to Aug. 31	37,172
Redfish	1890	June 30 to Aug. 30	49,689	Cohoes	1896	Sept. 12 to 27	2,667
Do	1891	June 16 to Aug. 15	58,096	Redfish	1897	June 25 to Aug. 3	12,764

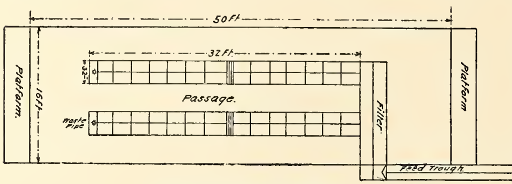
As the stream was not fished to any extent in 1886 and 1897, the average for the intervening ten years would be about 41,700.

KLAWAK HATCHERY.

Realizing the value of Klawak Stream to the cannery, and the importance of the natural spawning conditions in the lake and its feeders, the managers determined to try to improve the catch by operating a hatchery. Accordingly, in May and June, 1897, a hatchery, with a dwelling for the attendants, was erected on the right bank of the outlet, close to the lake and immediately below the upper rapids. The western end of the lake narrows so gradually that it is difficult to tell where it ends and the outlet begins, but the first or upper rapids seem to be the natural line of demarcation. Here the stream is from 150 to 200 feet wide, and falls and tumbles about 10 feet in a a cataract, immediately below which the hatchery site was selected. The water was conducted in a wooden trough from the lake above the rapids to the building, which was built from the bank out over a side eddy or widening of the main stream, so that a slight current flows under the building.

The hatchery is a substantial board structure, 50 feet by 16 feet, stripped over the joints to make it tight, and shingled with spruce shingles. It is lighted with five windows facing the timber and entered by a door at either end, from which a platform leads to the shore. The hatchery fixtures consist of 8 troughs, 16 feet long by 16 inches wide, placed in pairs, each 2 pairs end-on, so that there are 2 sets of troughs running 32 feet in length, broken in the middle, the 2 lower pairs in each set being 4 inches lower, allowing that much fall to the water for aeration.

The water is conducted from the lake above the rapids in a V-shaped trough to the upper end of the building on the river side, and, after passing through a large sluice box packed as a filter and running across the heads of the hatchery troughs, is conducted through them. These troughs are made of planed lumber well coated with asphalt varnish, with sheet-iron partitions also coated with asphalt, and are so arranged as to give sufficient space for handling the baskets and to permit the circulating water to pass under the partition at the head and over the one at the foot, thus percolating through the eggs; that is, there are two partitions separating each basket compartment. The upper partition extends to the bottom of the trough and is of such height as to allow the water to flow over the top. The lower one is of such height as not to permit the water to flow over it, but is raised from the bottom of the trough so that the water flows under. They are regular Williamson troughs.



Plan of Klawak Hatchery.

On the bottoms of the troughs are small sheet-iron rests, varnished, which permit the baskets to rest upon them and clear the bottom by about 1 inch. The troughs have compartments for 56 baskets. The latter are of woven wire, 7 parts to the inch, and are 24 inches by 14 inches by 5 inches. The number of eggs placed in each basket here is 50,000, giving the troughs a capacity of 2,800,000. As the passageways are very wide, the capacity of the hatchery could very easily be increased a half, making it 4,200,000. The waste water is returned to the stream by iron pipes at the foot of the troughs. The hatchery was ready for work July 25. Early in July the first redfish were seen in the lake, and on July 25 fish were seen in the trap at the mouth of Half-mile Creek. On August 1 a ripe female was captured and stripped, and from that day there was a gradual increase in numbers until September 10, when they were at their height and 60 females were stripped. The last stripping took place September 14. Early in September heavy rains set in, causing the highest floods known at the cannery, and washing out the traps so that no fish could be obtained after the 14th. It is believed that under average conditions many ripe fish could be obtained after that date.

The males first arrived in considerable numbers, followed closely by the females. It was noticed here, as in Redfish Bay, that there were more males than females. The total number of eggs taken during the season was 2,023,000, of which number about 800,000 were hatched and the fry returned to the lake. There were about 4,000 eggs

to the fish. The small percentage hatched was due to fungus, inexperience and the high temperature of the water in the lake being factors. Of the eggs fertilized on August 1 the eye-spots appeared in 18 days, and a few were hatching out September 13, but died immediately. The first fish to survive hatched out September 16 (47 days), and the first were planted on October 12. A short season of very warm weather raised the temperature of the surface water abnormally. When the temperature was taken it was 65°, and it is believed to have been much higher.

After the first set of eggs had been in the trough about a week a slime or fungus gathered on the wirework of the baskets, the eggs sticking together and dying. At this time the water was carried to the distributing trough and thence through the hatchery troughs direct from the lake. A distributing trough for one set of baskets was then packed for a filter with coarse gravel and charcoal, and then layer by layer with finer material to the top, and at the time of my visit the second distributing trough was being prepared in the same manner. This filter relieved the slime or fungus somewhat, but did not stop it altogether.

The appliances in the Klawak hatchery seem all very good, and the methods are those usually adopted at standard stations.

The eggs for the hatchery were obtained from fish taken at the Half-mile Stream and at the Three-mile Stream, on the northern side of the lake. The former has its source in two small lakes and empties into the large lake by a short delta in three arms. It is accessible to fish for about a mile, when it flows over a fall too high for fish to ascend. On the day of our visit the stream was much swollen by the heavy rains; two of the arms were about 30 feet in width, and the third 25 feet, with an average depth of 18 inches. Under average conditions there is very little water flowing in any but the middle arm, and at its mouth is a trap of stakes bound together, elliptical in form, the long diameter touching the banks at the extremities. On the lake side it is arranged in two places with circular openings having stakes pointed inward and converging like the opening in a rat trap, allowing the fish to enter, but not to leave. The fish entering here and impounded are removed by a dip net and, if ripe, they are stripped at once and the eggs fertilized; if not ripe, the fish are returned to the lake. The fertilized eggs are then carried by boat to the hatchery and placed in the hatchery troughs.

The Three-mile Stream also empties through a delta, but is much larger than the Half-mile Stream. It rises in the mountains, a large part of the water flowing over a high cascade. The water is clear and pure, and of an even, low temperature summer and winter. It has a gravel bottom and a large supply of fish. The redfish spawn in this stream for a long distance, and the hatchery in the summer of 1897 drew largely upon it for its supply of eggs. A trap similar to the one described has been placed here.

The stream at the head of the lake has not been thoroughly tested, but it is known to be large and that redfish spawn in it in numbers. It flows from a chain of lakes.

All these streams have ideal bottoms for nesting, and in my opinion the natural conditions for spawning can not be surpassed. There are few, if any, localities in southeast Alaska so well adapted for a hatchery site. If the Government should ever desire to establish a hatchery in this region it is believed that here the greatest success could be obtained with the least expenditure of money. Not only are the natural conditions superior, but by an easy trail the lake is only 2½ miles distant from Klawak, which has a monthly mail.

SAR-KAR AND VICINITY.

Sar-Kar is on the western side of Prince of Wales Island, at the lower end of Shakhine Straits, above the village of Tuxecan, and about 40 miles from Klawak. The stream is claimed by Mr. Fred. Brockman, who lives here, operates a small saltery, and sells fish fresh to Klawak cannery. The price varies, but about 4 cents is paid per fish, the cannery steamer calling for them. Mr. Brockman salts a few humpback bellies (300 half-barrels in 1897) and such other fish as are not called for by the cannery steamer. The average number of fish delivered to Klawak from this stream is 16,000 redfish and 9,300 cohoes. These numbers represent the capacity of the stream.

The following is the record so far as it can be obtained:

Year.	Redfish.		Cohoes.	
	Dates.	Number.	Dates.	Number.
1887	July 3 to Aug. 4	6,476		
1888	June 28 to July 11	6,834	Aug. 7 to Sept. 8	14,528
1889	July 3 to Aug. 30	11,555		
1890	July 6 to Aug. 16	16,267	July 25 to Sept. 6	15,331
1891	June 23 to Aug. 21	35,033	Aug. 19 to Sept. 10	9,033
1892	June 24 to Aug. 19	24,024	July 27 to Aug. 23	4,700
1893	June 24 to July 30	9,797		
1894	July 7 to Aug. 2	12,678		
1895	June 26 to Aug. 31	11,636	July 21 to Sept. 4	3,830
1896	June 18 to Aug. 2	20,480	Aug. 2 to Sept. 2	9,643
1897	June 25 to Aug. 17	21,667	Aug. 17 to Sept. 1	8,207

Warm Chuck is a stream in the vicinity of Tuxecan, and some years furnishes as many as 8,000 redfish.

Tok-Hehe and Ka-Hehe are other small streams in the same locality, from which 1,000 to 2,000 redfish were taken some years ago.

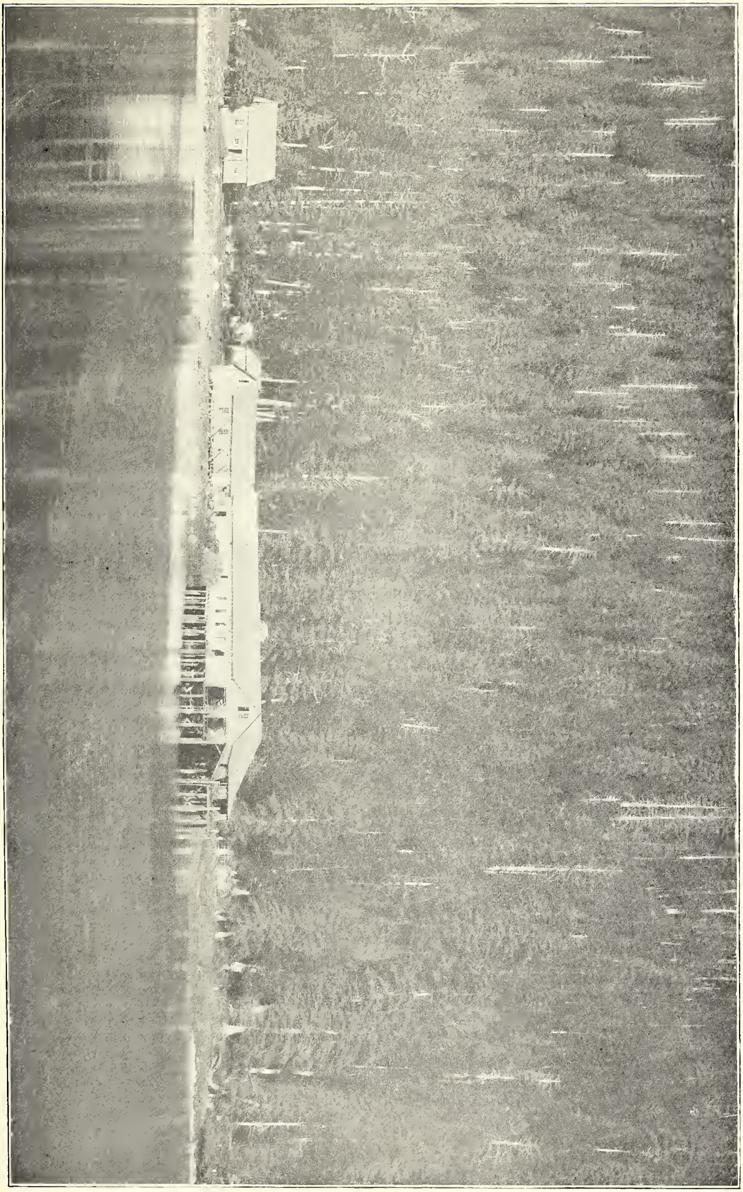
Eeke, Sukkwan, Kassook, Klakas, and Hessa, from which some years ago fish were obtained for the Klawak cannery, have been described.

The cannery steamer with a fishing crew visits the smaller streams in the vicinity where no regular fisheries are established and makes the catch by means of drag seines. Traps have been tried in the inlet at Klawak; one was driven in 1897 at an expense of $2,000, but without success warranting the outlay. Gill nets have also been tried, but with very little success.

REDFISH BAY.

Redfish Bay is on the western coast of Baranoff Island, about 58 miles south of Sitka. The head of the bay opens out and affords good anchorage for moderate-sized vessels, and at its extreme end is the cannery of the Baranoff Packing Company. This company built a cannery at the Redoubt, about 12 miles below Sitka, in 1889, and operated it that year and in 1890. It was then moved to its present location on Redfish Bay, making the first pack there in 1891. It has been operated every year since its organization, and has a capacity of 500 cases a day.

In 1896 and 1897 the cannery employed 17 natives as fishermen, and 3 whites and 31 Chinese in the cannery. They used 2 drag seines, 125 fathoms long, valued at $1.50 per fathom. One steamer, the *Wigwam*, of 24 net tons, with a crew of 5, and valued at $10,000, was employed. A chartered vessel transported the outfit in the spring and the pack in the fall. Four seine boats were used, valued at $75 each. The cannery is valued at $12,000, which includes buildings and machinery.



CANNERY AT REDFISH BAY.

The following table gives the pack for 1896 and 1897:

Species.	Dates.	No. of fish.	Cases packed.	No. of fish per case.
Redfish	June 22 to Aug. 20, 1896	103,541	9,338	11
Cohoes	Aug. 15 to Sept. 25, 1896	10,825	2,157	5
Humpbacks	July 19 to Aug. 31, 1896	....	3,863	23
Redfish	June 27 to Aug. 28, 1897	64,509	4,058	11
Cohoes	Aug. 2 to Sept. 14, 1897	8,351	1,576	5
Humpbacks	July 19 to Sept. 1, 1897	....	8,436	23

Though the average number of fish per case in 1897 is given the same as for 1896, it seems much higher for redfish, on account of the large number of fish from Necker Bay, which run as high as 30 to the case, and have not been considered in the average.

The Chinese contract was at 44 cents per case; the fishermen were paid $1.75 per day and board. As there is the same trouble here in holding the native labor throughout the season, $1.50 is paid and the remainder reserved until the end of the season, when, by contract, it is forfeited if the native leaves without permission.

The cannery is small, having an output slightly less than that of Klawak. It has no regular fishing stations and purchases fish only incidentally. The steamer goes from stream to stream where it is believed that fish may be obtained, and when loaded it returns to the cannery. If a stream is found having a good run of fish, a seining gang is left there. The streams are scattered over a territory fished by no other cannery, and range on the outer coast from Cape Ommaney to Cross Sound and on both sides of Chatham Strait from Icy Straits to Cape Ommaney. It is one of the hardest fishing routes in Alaska. The streams all lie in unsurveyed districts, and as a rule are small and uncertain. A stream that yields 4,000 to 5,000 redfish one year may not have enough the next to feed a native family. A stream in Chatham Strait, fished by this cannery, was prospected secretly and independently one year with great success by different parties. The following year they met at the mouth of the stream with big outfits, neither previously knowing the other's intentions, and where there had been thousands of fish the year before, there were not enough to salt a dozen barrels.

The cannery is at the extreme end of Redfish Bay, which runs north-northwest and south-southeast. The mouth of the home stream is west from the cannery about 300 yards.

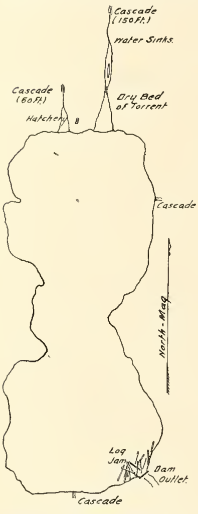
REDFISH BAY STREAM.

This is a lake outlet and flows from the lake in a general east-southeast direction over a rocky bed, with considerable velocity. The stream is about half a mile long, and the width between banks is 50 feet, though at the time of our visit it did not flow more than 8 inches deep at a point where it was 20 feet wide. There are numerous low falls and rapids, but none which prevent redfish or cohoes from ascending, though it is doubtful if humpbacks or dog salmon enter the lake. From appearances the volume of discharge varies largely.

The lake is hour-glass-shaped, and has a greatest length of 1½ miles in a north-and-south direction, with a greatest width of ½ mile at the southern end. Except at the outlet, the lake is hemmed in by very precipitous mountains from 800 to 1,500 feet high, in some places rising nearly vertically 600 or 800 feet. On approaching the northern end, however, it is seen that the mountains lie a short distance back, leaving a rising wooded shelf a few hundred yards wide, except on the eastern side where the dry bed of a torrent appears in a narrow canyon, which extends back about a mile and ends in a cul-de-sac.

The lake is fed by a number of cascades, several of them very beautiful. There is absolutely no stream flowing in over a bed in which fish can spawn. The cascades either tumble directly into the lake or by a series of short waterfalls. At the head of the lake on the eastern side are the several dry, bowldery beds of a torrent, previously alluded to, which form a junction about a quarter of a mile from the lake, and then continue as one bed, except where the stream in its flood has met some obstruction and has torn its way through by several channels, carrying everything before it.

About half a mile from the lake a considerable flow of water falls over a log jam into a pool, where it is swallowed up. Advancing farther, the stream increases in volume and the mountains come close together, until the bed is hemmed in by a narrow gorge, and one looks up vertically to the top of the mountain. In one place there is a sheer fall of 800 to 1,000 feet. About a mile from the lake the gorge ends, and the stream falls over the comparatively low gap in a beautiful cascade about 150 feet high. The rise from the lake to the cascade is about 1 to 10. The question is, What becomes of the water? On examination it is seen that huge slides from the surrounding mountains are not infrequent, and that the timber bordering the bed of the torrent grows upon the detritus; in fact, the whole shelf at the upper end of the lake is of the same material—great angular blocks, grading down to finer material. Great trees, torn up by the roots and piled in with rocks carried down, are scattered everywhere; bowlders piled up in fantastic shapes—all show the violence of the torrent. Trees that have been thrown across the stream and jammed have great hollows pounded in the upper surfaces by the rocks as they are swept onward by the current. This shelf, then, consists of these angular blocks; they are not waterworn, and there is no large amount of fine material. This formation probably extends to a considerable depth, and in the bed of the stream it permits the water to percolate through the interstices and find its way by seepage into the lake. When the stream is at its flood the volume is too great to sink away, and it flows into the lake as a torrent over what was a dry bed at the time of our visit.

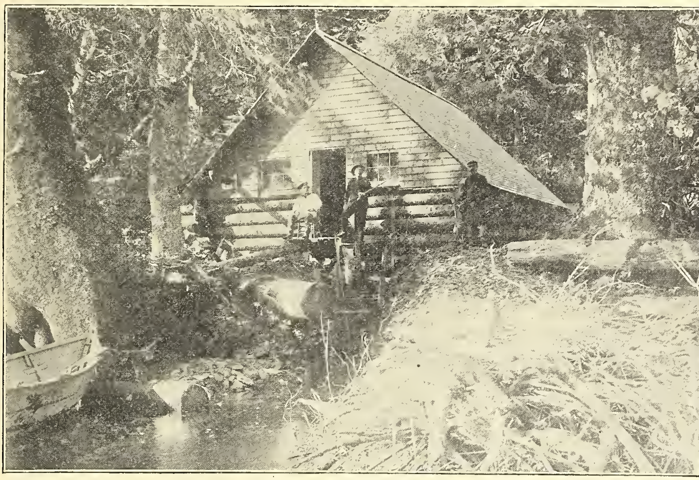


Sketch of Redfish Bay Lake.

Under such conditions the redfish must spawn in the lake, and the cannery foreman, who winters here, states that he has frequently observed them spawning on the shelf off the dry bed of the torrent, making no nests. This shelf is poorly adapted for spawning-beds. It is only a few yards wide when it drops off into deep water, and is composed of rocky material that could not be used for nesting. The peculiar conditions that prevail here in reference to these spawning-grounds are exceedingly interesting, from the fact that redfish not only spawn in the lake, but under conditions entirely different from those usually believed to be necessary. Yet the stream can be relied upon for redfish, and a large number are taken very year in the vicinity of its mouth, or on the fishing-ground; the average catch during seven years was 34,903, the largest number, 69,553, being taken in 1894. At the point selected for spawning-beds the salmon

are under the influence of the water seeping through under the dry bed of the torrent, which is probably of different temperature and conditions from the lake water.

At the head of the lake, on the western side, several streamlets discharge from a cascade that spreads over the face of a vertical rock a few hundred yards back from the shore line. On the lake shelf at this point the cohoes spawn, and if the streamlets are swollen they work their way into the mouths, where small pools are formed. The water level of the lake varies greatly, and when the cascades freeze the lake falls, and, as the cohoes spawn so high up on the lake shelf, their eggs are exposed and lost. To remedy this a dam was constructed in 1897 across the outlet at the lake end, with a central opening about 6 feet wide. After the fish are all up, and before the cascades



Hatchery at Redfish Bay.

freeze, it was the intention to close the opening of the dam, so that the lake may be held at a level sufficiently high to keep the eggs covered.

The run of redfish here usually extends late in the season. During the time of our visit (September 5 to 8) some of them taken in gill nets looked as if they were just in from the sea. The cannery could have made large hauls at this time, but care has been taken not to overfish, so as to have as many fish as possible enter the lake. The foreman stated that in 1896 he first noticed red salmon spawning on November 3, and from that time they were seen in large numbers until December 2; after that date only occasional ones until Christmas, and after that none were seen. The cohoes, though much later to run, commenced spawning October 3, continuing into January.

The company operating the cannery, appreciating the value of the home stream, and desiring to increase its output, built a hatchery during the summer of 1896, and finished

it in time for experimental work in the fall of that year. The hatchery is located at the head of the lake, between the dry bed of the torrent and the streamlets flowing from the cascade, and near the latter. It consists of a log and rough-board building, 20 by 30 feet, shingle-roofed, having at one end a room partitioned off for the superintendent's quarters, and in the space at the other side of the same end, a boiler and pump were installed in 1897.

There are eight hatching-troughs, each 16 feet long, 12 inches wide, and 11 inches deep, made of unplaned and unpainted boards, 1 inch thick and 12 inches wide. They are arranged in three pairs and one against the wall, on either side of the building, leaving four passageways between them. There are six compartments in each trough, 30 inches long, separated by solid wooden partitions 6 inches high, joined tightly to the bottom and allowing the water to flow only over the top. In each compartment are two $\frac{1}{8}$-inch round iron rods, fixed transversely $\frac{1}{4}$-inch from the bottom, for the baskets to rest upon. The baskets are 24 by $10\frac{1}{2}$ by 6 inches, and hold about 25,000 eggs.

Water from the cataract, a few hundreds yards back of the hatchery building, is conducted by a box flume to the northeast corner of the hatchery building into a transverse distributing-trough, from which it passes through the hatching-troughs, and thence by a waste-pipe out of the building. The arrangement of the partitions allows only circulation over the top. There was no record kept of the operations in the fall of 1896. About one week after they had commenced to gather eggs, and had 200,000 in the baskets, unexpected cold weather set in and not only froze the flume solid, but froze up the whole cataract. Being without water, the eggs were put in the lake and left to their fate. It was the intention for 1897, in the event of a freeze, to pump from the lake and use a filter. The water from the cataract is about 8° lower in temperature than the lake water. The fish are taken from the lake in seines, and those that are ripe are stripped, while the rest are returned to the lake.

The following is the record of Redfish Bay Stream since 1890:

Species.	Year.	Dates.	Number.	Species.	Year.	Dates.	Number.
Redfish ..	1890	July 18 to Aug. 24 .	24,367	Redfish ...	1895	June 28 to Sept. 21.	40,969
Do....	1891	July 9 to Sept. 26 ..	*53,310	Do.....	1896	June 1 to Aug. 10 ..	15,000
Do....	1892	July 6 to Aug. 6 ...	48,000	Do.....	1897	June 1 to Aug. 10 ..	20,000
Do....	1893	July 14 to Sept. 2 ..	26,434	Cohoes ...	1893	Aug. 21............	303
Do....	1894	July 29 to Aug. 12 .	69,553	Do.....	1895	Aug. 26 to Sept. 21 .	1,512

* Includes a few cohoes.

VICINITY OF REDFISH BAY, ETC.

Little Whale Bay, about 20 miles to the northward of Redfish Bay, has a stream from which 2,000 to 3,000 redfish and the same number of cohoes are taken.

Necker Bay, next north of Whale Bay, has a stream which is remarkable for the large run of *small* redfish. The average number of fish per year taken from this locality by the cannery during the past nine years is 40,000; the largest number in any one year was 105,572. They are fully matured, I am told, and run from 28 to 30 to the case. This would give an average of rather less than $2\frac{1}{2}$ pounds in weight, and it is asserted that every year the fish average about the same in weight.

The Redoubt, referred to under the cannery history as the first location of this cannery, has a short outlet to a large lake and was a favorite place of the Russians and the principal source of salmon supply for the Sitka colony. It was dammed solidly for years, and from a stream out of which many thousand salmon were formerly taken each year, the catch has dwindled down to about 6,000.

PLATE 47.

GORGE AT HEAD OF REDFISH BAY, LEADING TO LAKE.

CASCADE NEAR HATCHERY, REDFISH BAY.

Cape Edward, Smith, Olsen, and O'Hara bays are on the outside of Chichagof Island, and Surge Bay is on the outside of Yakobi Island. All are unsurveyed localities, from which a few redfish are taken for Redfish Bay cannery.

Sitkoh Bay, Gut Bay, Falls Creek, Point Ellis, Kuiu Bay, Shipley Bay, and Point Barrie in Chatham Strait are localities from which a few redfish are caught for the same cannery. All these streams should be examined; probably none of them are of much importance; still the negative evidence may be of value. It is said that formerly many of these streams were barricaded, but that they are now all open.

ASTORIA AND ALASKA PACKING COMPANY.

A cannery was built by this company in 1889, in Pavlof Harbor, Freshwater Bay, on the eastern side of Chichagof Island. Messrs. Sanborn & Ellmore, of Astoria, were the promoters of the enterprise. It made a pack in that year, and in the spring of 1890 was moved to the South Bay of Pillars (Point Ellis), on the eastern side of Kuiu Island, packing that year and also in 1891. It was burned in May, 1892. The cannery was located on the southern shore of the bay.

The streams fished for this cannery were the following:

The home stream, known usually as the Point Ellis Stream, at the head of South Bay of Pillars, from which in 1891 the cannery obtained 35,000 redfish, 5,000 cohoes, and 100,000 humpbacks.

Pillar Bay Stream is at the head of the North Bay of Pillars, and is said to have furnished the cannery in 1891 with a large number of cohoes and humpbacks. A small saltery is now located here and operated by Mr. Jack Mantle.

Near the head of Tebenkof, or Kou Bay, is a stream usually known as Kuiu Stream, which in 1891 furnished the cannery with a large number of redfish, cohoes, and humpbacks. A few fish were also taken from several small streams on Baranof Island, and from Sitkoh Bay on Chichagof Island, none of which were visited.

Baranof Island has a number of streams in which redfish are found, but except Redfish Bay and Necker Bay they are said to be unreliable, and at best carry a very limited number. This is also true of Chichagof. Frequent inquiries were made about Admiralty Island, but only two redfish streams were heard of, and these are doubtful.

This country has all been prospected over, and it is thought that the streams are fairly well known; but a further visit to all these localities should be made, so that some definite knowledge in relation to them may be on record.

KILLISNOO.

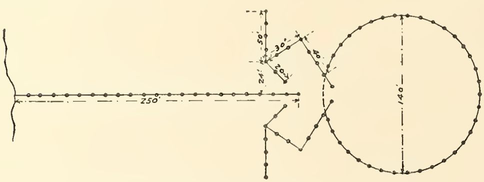
Killisnoo is on the northeastern side of Kenasnow Island, close to the western shore of Admiralty Island, opposite Peril Straits, and about 3 miles south of the entrance to Kootznahoo Inlet. It is a regular calling-place for the steamers of the Pacific Coast Steamship Company. It has a post-office, store, Government school, and a Greek chapel. In 1890 the regular population was 79. The works of the Alaska Oil and Guano Company, incorporated with a capital stock of $75,000, are located here. The business of the company is to extract the oil from the herring and convert the refuse into guano. Incidentally a few salmon and herring are salted.

In 1880 Messrs. Spuhn & Vanderbilt came to Alaska, operating under the title of the Northwest Trading Company, for the purpose of establishing stores for trade with the natives. One store was located at Killisnoo, an old Hudson Bay Company station.

As herring were plentiful in the inlet at Kootznahoo, a small plant was installed in 1882 for extracting oil, simply in an experimental way, and as it proved successful it was gradually enlarged until its present capacity is said to be 1,800 barrels of herring in twenty-four hours, or 350,000 gallons of oil, 1,500 tons of guano, and 1,000 half-barrels of salt herring for the season. As prices are now low, the works are not run to their full capacity. In 1884 the plant for the manufacture of guano was installed and operated. In 1888 the Northwest Trading Company, which also built the Pyramid Harbor salmon cannery in 1883, went into the hands of trustees, and the present company was organized.

The works are quite extensive, the buildings large, machinery excellent, storehouses roomy, wharves commodious, and the plant similar to the menhaden oil works on the eastern coast. The common barrels used are made on the place by machinery.

The steamer *Dolphin*, of 60 tons net register, valued at $10,000, with a crew of 18, including fishermen, is used for cruising through interior waters for fish. The steamers *Favorite* and *Louise* operate in the inlet with scows, using 3 purse seines, 125 to 150 fathoms long, 12 fathoms deep, ½-inch stretched mesh, valued at $1,000 each, fully rigged. The *Favorite* is 42 tons net, and is valued at $5,000; it has a crew of 16, including fishermen, viz, 6 whites, 9 natives, and 1 Chinese cook. The steamer *Louise* is 5 tons net, valued at $3,000, and has a crew of 3. Three lighters, worth $800 each, and 8 seine boats, valued at $125 each, besides numerous skiffs, etc., are employed. This year a trap was driven in the inlet, but at the time of our visit it had not proved satisfactory. In and about the factory 17 whites, 35 natives, 3 Chinese, and 5 Japanese are employed.



Sketch of herring trap at Kootznahoo Inlet.

The white fishermen are paid $50 a month, and board; the native fishermen get $1.50 a day, or practically $45 a month, for they are paid even if detained, and while board is not stipulated they practically get it. Laborers generally have $1 a day, but about 10 of them, who have been employed a long time and are faithful, having the more difficult work to do, receive $1.50 per day. Boys are paid 50 cents a day. A good native fisherman or laborer makes about $200 a season. All wages are paid in cash, the company disbursing $10,000 to $15,000 a year to the natives and the few white men who make Killisnoo their home.

The factory is ready for operation from July 1 to December 31.

A barrel of herring weighing 200 pounds contains from 700 to 800 fish. The price of pressed oil is 30 cents a gallon, crude oil 25 cents a gallon, the refuse of the pressed oil 20 cents a gallon. The guano brings from $25 to $27 per ton. The oil goes largely to San Francisco, New York, and England, and is used for tanning, the manufacture of soap, and adulterations. A considerable portion of the guano is sold in Hawaii.

During the spawning season the herring are very poor and furnish no oil; it is not until June, when their food appears, that they commence to fatten. In that

month one barrel of herring will furnish about half a gallon of oil, sometimes less; from this time the oil increases until the early part of September, when about $3\frac{1}{2}$ gallons of oil are obtained from one barrel of fish. It then decreases, and in December a barrel of fish will furnish about 2 gallons of oil.

One hundred barrels of herring make $2\frac{1}{2}$ tons of dry fish-guano. This is simply fish refuse dried in retorts after the oil has been extracted, and containing 8 to 10 per cent of moisture.

In 1896 the output was as follows: From 27,750 barrels of herring there were made 90,650 gallons of oil and 550 tons of guano. This is the smallest output of oil since the second year of operation. 250 half-barrels of herring, 25 barrels of salmon, and 150 half-barrels of salmon bellies were salted.

At the time of our visit the oil and guano works were running to their full capacity, and the statistics for 1897 could not then be obtained. Later it was learned that the catch for 1897 amounted to 35,000 barrels of herring, from which 125,000 gallons of oil were prepared, valued at 25 cents per gallon, 780 tons of fish fertilizer valued at \$27 per ton, and 950 half-barrels of salt herring valued at \$3.50 per half-barrel. The season was poor, owing to stormy weather.

The herring of southeast Alaska are small, but in season are rich in oil and of delicious flavor. They are found in many localities running in immense schools, some years in smaller numbers, in fact almost disappearing where formerly they were abundant, and appearing in localities not visited before, only to return after several years to their former feeding-grounds. As herring are food for other fishes, and as it is said of these fish that they are found where the bait is, so it may be said that herring go with *their* bait, which is said to be a small crustacean occurring in some places in myriads.

In April the herring come to the shores in countless numbers to spawn, depositing their eggs in the sea grass, rockweed, and on the bushes hanging in the water. At this time the Indians plant hemlock twigs at the low-water mark, where they become covered with spawn, after which they are gathered in canoe loads. The spawn is heaped upon the twigs, to which it adheres in grapelike clusters, which are sometimes called "Alaska grapes," and is consumed by the natives in large quantities, either fresh or dried, and cooked as occasion demands, and for winter use. Usually it is eaten with rancid oil, which is the sauce that goes with all their delicacies, even with berries.

For many years the inlet at Kootznahoo has been the favorite resort for herring, though lately they seem less abundant. They are found in great numbers on the northern shore of Kuiu Island and at times many are taken in the vicinity of Juneau. The steamer *Dolphin* cruises through all the interior waters and makes a catch wherever herring are found. Cetaceans, halibut, king salmon, and other fish follow the schools and consume immense numbers.

The Indians use the herring only during the time they are present in their waters, curing none for winter food. In catching them for their own use a long stick or pole having at the end, and for some distance from it, a large number of sharp-pointed nails, is swept through the water, with a paddle-like motion, like a rake, impaling the fish on the nails. At the end of the movement the pole is brought over the canoe, given a shake which detaches the fish, and then thrust into the water again. In this manner a canoe load is quickly made.

The following is the output of the company since its first operations at Killisnoo:

Year.	Oil.	Guano.*	Herring.	Year.	Oil.	Guano.	Herring.	Salted.		
								Herring.	Salmon.	Salmon hellies.
	Gallons.	*Tons.*	*Barrels.*		*Gallons.*	*Tons.*	*Bbls.*	*Half bbls.*	*Barrels.*	*Half bbls.*
1882	30,000	None.	No record.	1890	156,750	None.	52,425			
1883	81,000	None.	42,000	1891	242,050	800	88,222			
1884	192,000	600	66,000	1892	318,900	700	93,580			
1885	300,000	No record.	85,000	1893	223,450	900	72,250			
1886	368,000	No record.	110,000	1894	234,350	800	76,530	1,000		† 50
1887	335,000	No record.	111,000	1895	101,650	500	32,550	500		
1888	100,000	No record.	30,000	1896	90,650	550	27,750	250	25	150
1889	157,900	None.	52,460	1897	125,000	780	35,600	950	105	275

* The amount of oil and guano made depends upon the demand; some years there was no market for guano.
† Salt codfish.

The following shows the output of salted salmon for 1897:

Species.	Number of fish.	Average weight.	Price paid for fish.	Product.	Price received.
		Pounds.			
King salmon	350	16	1 cent per pound, live weight.	25 barrels	$10.50 per barrel.
Redfish	6,000	6½	5 cents each	75 half-harrels of hellies	$6 per half-barrel.
Cohoes	2,500	10	1 cent per pound	80 barrels	$8 per barrel.
Humpbacks	22,000	3½	1 cent per fish	200 balf-barrels of bellies	$5 per half-harrel.

The redfish and humpbacks salted here are purchased from Indians, who take them with seines in the small streams in the vicinity, the redfish from the middle of June to the beginning of August, and the humpbacks from July 15 to August 15. The king salmon and cohoes are taken entirely by trolling. An ordinary salmon hook, baited with fresh herring placed lengthwise over the hook, is used. The best results are obtained near the schools of herring. The king salmon seem to follow and feed upon them, and can be taken at all times when the herring are in, but they are more abundant in certain months. In April and May they are plentiful enough for local consumption. Salting is commenced in June, and continued throughout July and August, or until the herring run in such large numbers that all the force must be employed in making guano and oil. The king salmon, however, continue abundant and are taken, though in diminishing numbers, until January. There is no record of the capture of any in February, but several have been caught in March, and they can probably be taken every month in the year; but in the late winter, when everything is covered with snow and ice, no attempt is made to catch fish in any way. All king salmon taken here are in prime condition. A number seen on September 20 appeared as though fresh from the sea. The spawn was not advanced toward ripening, and the stomachs were full of herring. It is said that on the herring ground on the northern side of Kuiu Island, when the steamer is lying to, waiting for the fish to school, king salmon are captured at times in considerable numbers on an ordinary hand line baited with herring. In October, from the wharf at Killisnoo, king salmon from 10 to 12 inches long are frequently taken with hand lines (without sinkers) baited with herring. In Florence Bay, inside of Point Hayes, on the opposite shore, the Indians take large numbers of small king salmon on hand lines during the fall of the year.

Cohoes are also taken on trolls, but the season is short, usually from July 15 and throughout August.

Codfish are found in the vicinity of Killisnoo, but not in paying numbers. The company has sometimes salted 50 barrels a year, from the latter part of May to the

CANNERY AT PYRAMID HARBOR.

15th of August. Several years ago preparations were made to take codfish on a large scale, but the venture was unprofitable. It is believed that with a large equipment, and fishing over a wide area, 50 tons might be taken in a season.

Only very general information could be obtained at Killisnoo in reference to the salmon streams in the vicinity, and an investigation of the localities will be necessary to determine their importance.

BARTLETT BAY.

This is an arm of Glacier Bay, on Icy Straits. In 1890 a cannery was built on the bay by the Bartlett Bay Packing Company, and operated by Williams, Brown & Co., of San Francisco. A saltery was conducted here prior to that date, and in 1889 a pack of 4,300 cases was made in a crude way. Cans were carried to the locality, cookers improvised, and the pack was made by hand. In 1890 the cannery was built, and a pack made that and the following year, but none subsequently. The cannery entered the pool of the Alaska Packing Association of 1892, and was one of the canneries of the Alaska Packers' Association in 1893. In 1894 it was dismantled, the buildings were pulled down, and the place abandoned.

CHILKAT.

A long narrow peninsula projects into the head of Lynn Canal, forming two bays or inlets. The eastern one, called Chilkoot Inlet, again divides, the western arm receiving Chilkoot River; the eastern arm continues about 10 miles farther to the northward under the name of Taiya Inlet, and has at its head the villages of Dyea and Skagway. The western arm, or bay, of Lynn Canal, called Chilkat Inlet, receives the waters of the Chilkat about 9 miles from Seduction Point (the end of the peninsula).

In 1880, when it appeared that the salmon of the Columbia were becoming scarcer, with no adequate steps to restock the river, Mr. M. J. Kinney, then and now one of the large packers on the Columbia, started inquiries elsewhere with reference to future business. In 1882 he had the Chilkat territory prospected for fish, built a hut at Pyramid Harbor, and in 1883 he erected a cannery, under the name of the Chilkat Packing Company, on the eastern shore of the inlet, about a mile below the site now occupied by the cannery of the Chilkat Canning Company. A pack was made that year. The cannery changed hands several times, and finally was burned in 1892, and not rebuilt. The site is now owned by the Alaska Packers' Association. The cannery packed every year from 1883 to 1891, both inclusive, except in 1888, when it was closed.

A cannery known as the Chilkat Canning Company was built in 1889 by Messrs. Hugh Murray and David Morgan at Chilkat Village, on the eastern side of the inlet, and inside of Pyramid Island. It was operated from 1889 to 1893, and then sold to the Alaska Packers' Association and closed. It has not been operated since 1893, but is held as a reserve by the association. It has a capacity of about 800 cases a day.

PYRAMID HARBOR.

Pyramid Harbor is on the western side of Chilkat Inlet, 1½ miles south of Pyramid Island, and consists of a small cove in which two or three vessels may find anchorage. The cannery of the Pyramid Harbor Packing Company is on the southern shore of the cove. It was built in 1883 by the Northwest Trading Company, at the time that company was established at Killisnoo, and operated in 1883 and 1884. It was idle in 1885, and in 1888 was sold to D. L. Beck & Sons, of San Francisco, and

operated by that firm. In the spring of 1889 it was burned, but was rebuilt at once and a pack was made that year. In 1892 the cannery was a member of the Alaska Packing Association, operated that year, and in 1893 it joined the Alaska Packers' Association. It was afterwards enlarged, utilizing some of the machinery of the Bartlett Bay cannery. It is the only cannery that has made a pack in this vicinity since 1893. It has a capacity of 1,600 cases a day.

In 1896 14 whites and 87 Chinese were employed in the cannery. The company employed 60 white fishermen, and received fish from about 200 natives. The cannery fishermen used 12 gill nets, each 200 fathoms long by 16 feet deep, 8½-inch mesh, valued at 65 cents per fathom, for king salmon, and 46 gill nets, each 300 fathoms long by 10 feet deep, 6¼-inch mesh, valued at 65 cents per fathom, for redfish. The steamer *Elsie*, of 38 tons, with a crew of 5, and valued at $16,000, and the steamer *Lillian*, of 20 tons, with a crew of 4, valued at $8,800, were employed. The chartered ship *Invincible*, of 1,394 net tons, with a crew of fishermen, was used for transporting. Four lighters valued at $50 each, 48 Columbia river boats valued at $200 each, and several skiffs were also used.

The following table gives the statistics for 1896 and 1897, so far as obtainable:

Species.	1896.			1897.			
	Cases packed.	Average number per case.	Dates.	No. of fish.	Cases packed.	Average number per case.	Dates.
Redfish	44,044	10.3	June 25 to Sept. 12	321,517	31,241	10.3	June 25 to Sept. 13
Cohoes	612	7.5	Aug. 28 to Sept. 12	11,123	1,488	7.5	Aug. 29 to Sept. 13
King salmon	2,800	3.1	May 25 to June 25	14,796	4,727	3.1	May 28 to June 28

In 1897 the same equipment was used. At the beginning of the season the same number of white fishermen was employed, and the fish were received from about 300 natives. After the gold excitement reached Pyramid Harbor many white fishermen left for the Klondike and many Indians left to freight across the passes.

The Chinese contract price was 40 cents per case. The fish obtained for this cannery, as well as for those others that had previously operated here, all came from the Taku, Chilkat, and Chilkoot rivers.

TAKU RIVER.

The Taku River is one of the largest of southeast Alaska, and empties into the inlet of the same name about 12 miles southeast of Juneau. King salmon, redfish, and cohoes run in the river, but on account of the wide expanse of the mouth, and the ice in the inlet, which is discharged constantly from the adjacent glacier, fishing can not be carried on profitably. The river is said to be navigable for canoes for a distance of 50 miles. It has a strong current and many tributaries, some of which are said to be lake outlets. As soon as the ice breaks up in the river (usually about May 25) the fishing for king salmon commences, and all that are packed at Pyramid Harbor are taken in the Taku, except a few stragglers that appear around the Chilkat very early in the season, which can hardly be called a run. The cannery usually expects to pack about 3,500 cases. These fish are all taken with drifting gill nets by white fishing crews. About 15 per cent of the king salmon are white-meated. The largest ever taken weighed 78 pounds. No other species are fished for in the Taku.

As soon as the redfish commence to run (usually about June 25), the king-salmon fishing ceases and the gear for redfish is put out, not because the king salmon stop running at that time, but because the redfish are more profitable.

CHILKAT RIVER.

The Chilkat River comes after the Stikine, Taku, and Unuk in size. It empties into the head of Chilkat Inlet over the extensive McClellan Flats. Canoes go some distance above Klukwan, the largest and principal Chilkat village. The Chilkat, while draining an extensive glacial region, has no tide-water glaciers around its mouth, and therefore is not obstructed by ice during the summer. The lower river valley is large and wide, but the water at ordinary stages is confined to a few channels, which flow around sand banks and marshy and wooded islands. The river proper has its source in the high ranges to the northwestward, near the headwaters of the Alsek. At Klukwan, about 20 miles above its mouth, the Chilkat receives as a tributary the water of the Tsirku, an outlet to Chilkat Lake. The lake is 5 miles long, and its greatest width is 1 mile. Its feeders are said to be spawning-beds for large numbers of redfish.

Most of the redfish are taken by the cannery fishermen with drift gill nets. Columbia river boats are used, each manned by two white men, or one white man and one native. The fishing is carried on in Chilkat Inlet between Glacier Point and McClellan Flats, a range of about 7 miles. The average catch for the season by the cannery fishermen during the past four years has been 300,000 redfish. The fishermen receive $100 for working the ship to Alaska and return to San Francisco, and 3 cents is paid the boat outfit for each king salmon, redfish, or coho taken; the men are boarded by the cannery. The cannery, besides obtaining fish from this source under its own supervision, purchases fish from the Chilkat and Chilkoot Indians.

The Indians fish from canoes moored to posts, or from platforms built over the streams. They use a large gaff (common among all Alaska Indians), consisting of an unbarbed hook about 4 inches across the bend, secured to a pole 10 or 12 feet long. This is thrust into the water, and when the Indian feels or sees a fish, he impales it and drags it ashore. When fish are plentiful the hook is simply dragged through the water. A large number of the fish from the Chilkoot are taken in this way.

CHILKOOT RIVER.

Chilkoot River empties into the head of Chilkoot Inlet and is the outlet of Chilkoot Lake. It is about 1½ miles long in a general northwest-and-southeast direction, and is one of the smaller streams of Alaska, but has a large run of redfish. The lake is about 2½ miles long and 1 mile wide, and is fed by glacial streams. More redfish are taken at Chilkoot than at Chilkat, as the fish are confined to a single broad channel and are more easily captured. The Chilkoot may be classed with streams like Hetta, Karta Bay, and Naha Bay. In 1896 the run of fish in this stream was so large that the cannery was obliged to limit the number purchased of each Indian fisherman to 100 per day.

The Chilkoot Indians supplied the Pyramid Harbor Cannery in 1894 with 62,284 redfish; in 1895 with 68,000; in 1896 with 159,000; and in 1897 with 48,000. The Chilkat Indians furnished 30,872 in 1897, this being the first year since 1893 that they supplied any fish. Four years ago they demanded 10 cents a fish, and as the cannery

refused to pay this amount, the Indians declined to furnish any fish. In 1897 a compromise was effected, the cannery steamer calling at the mouth of the Chilkoot and paying 6 cents a fish. The Chilkats deliver at the cannery and receive 8 cents a fish.

The small number taken in 1897 is due to the Klondike excitement. Most of the Indians stopped fishing and went to Dyea and Skagway to freight over the passes. About half of the white fishermen also left for the gold fields.

From the large number of redfish taken in Chilkat Inlet it is probable that the river is a very prolific redfish stream, but it is so broken in its course that fishing is very difficult. The earliest fish are a few king salmon, followed, the latter part of June, by the redfish, which continue running until late in September, when the dog salmon come in so thick and the redfish decrease to such an extent that it is barely profitable to take them. The humpbacks also run in large numbers in September. The Chilkat redfish are regarded by packers as the choicest in Alaska.

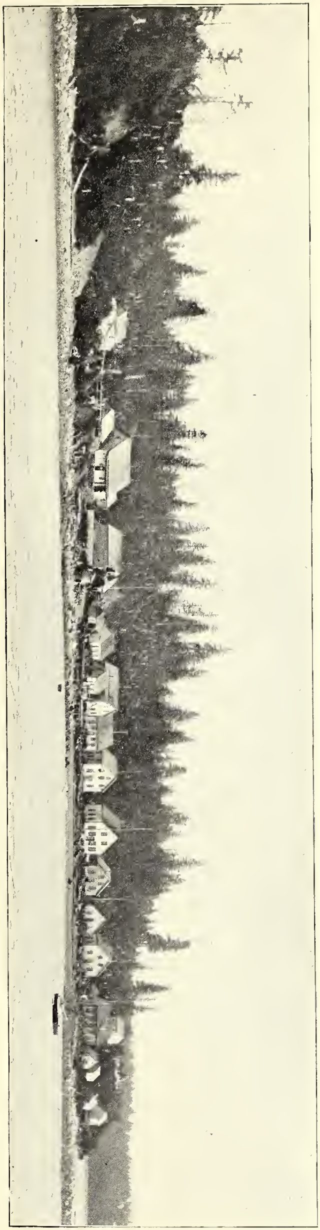
The run in the Chilkoot begins a little later than in the Chilkat. The redfish in both streams are about the same average weight and size, but fishermen claim that they can recognize a difference in shape, and it is stated that a Chilkoot fish is very rarely found on the Chilkat side of the peninsula, and vice versa.

Seines have been tried unsuccessfully, probably because there are no good seining beaches.

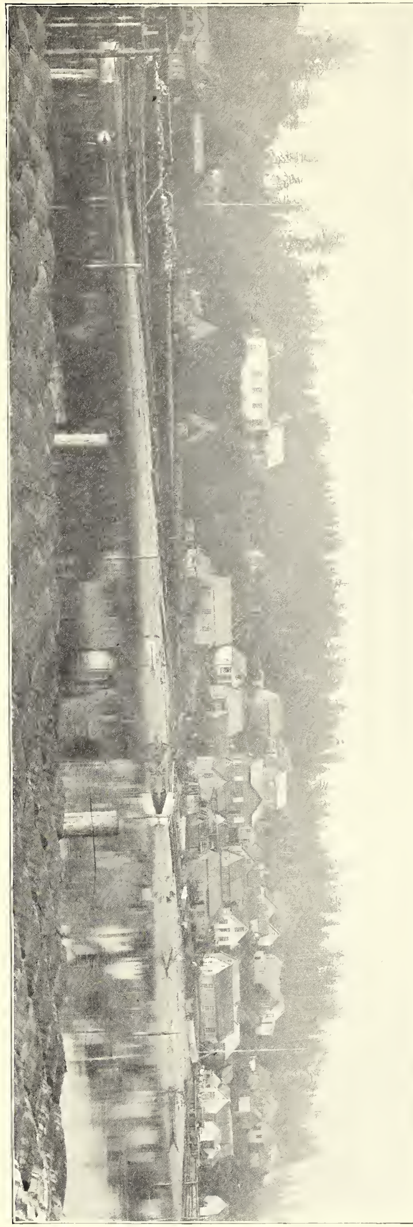
A sturgeon was taken in the Taku in 1896 weighing 12 pounds, and one in the Chilkat the same year of similar weight. No steelheads have been noticed, but Dolly Varden trout are numerous during the season.

It was learned from white people in the vicinity that the Indians also use nets in both rivers, blocking all the channels and entering streams, in all directions, to make the catch, and that they fish on the spawning-grounds. It was also reported that not only is Lake Chilkoot fished, but the spawning stream as well, and that traps have been placed in the lake under the guidance of an expert. The gill-net fishermen are reported not to observe the weekly close season.

With the Chilkat region the examinations conducted in 1897 by the *Albatross* in southeast Alaska were finished. They include all the canneries and a number of the fisheries, but there are still a large number of streams to be examined in the future. There are said to be redfish streams entering Swanson Harbor, Bartlett, Dundas, and Taylor bays, Idaho Inlet, and Port Althorp. Probably none of these streams contain many redfish, otherwise the cannery at Bartlett Bay would not have been abandoned. At Port Althorp there was a saltery operated by Ford & Stokes, now said to be abandoned. At the southern entrance to Cross Sound is Yakobi Island, separated from Chichagof Island by Lisianski Strait. Surge Bay makes in to Yakobi Island on the western shore, and has a stream fished some years by the Redfish Bay cannery, from which as many as 16,000 redfish have been taken. South of Point Urey is a large sound or strait, with numerous arms, bordered by islands, rocks, and reefs, on the ocean side of Chichagof Island. On this sound are Stranger River, O'Hara Bay, Olsen Bay, and Smith Bay, having redfish and coho streams, and fished at times by the Redfish Bay cannery.



YAKUTAT.



KILLISNOO.

PRINCE WILLIAM SOUND AND COPPER RIVER REGION.

After leaving Chilkat there are no canneries until Prince William Sound is reached, or, as the locality is sometimes called, the Copper River Delta. As plenty of capital is ready to be placed in canneries, this long stretch has probably been well investigated. The absence of canneries would seem to imply the absence of fish, but the inaccessibility of the region probably accounts for the slight development of its fishery resources.

The district has contributed 6.6 per cent of the cannery output of Alaska since 1889. Its share in 1897 was 5.7 per cent.

The *Albatross* called at Yakutat to make inquiries relating to the fisheries, but little information could be obtained. This village contains about 300 Indian inhabitants, and lies on the seaward slope of the great Fairweather Range and the St. Elias Alps. The Indians obtain all their fish supply here, from a few small streams in the vicinity. They speak in glowing terms of the abundance of fish, but without any conception as to the numbers necessary for commercial purposes. There are several glacial streams emptying into Yakutat Bay, and all are said to carry king salmon. The fisheries are, however, entirely undeveloped, and it would take at least a season's work to make even a partial examination of the waters.

About 60 miles east of Yakutat the Alsek River empties through a delta into Dry Bay. According to the Indians, this river carries a large number of king salmon, redfish, and cohoes. Between the Alsek and Yakutat four smaller rivers empty into lagoons or inside channel-ways which communicate with the sea through shallow channels, and all are said to contain many salmon in season. It is said that a canoe can be carried through these inside channels from Yakutat to the mouth of the Alsek, but there is no entrance seaward for a vessel. The combined catch of these rivers would perhaps be sufficient to supply a cannery, but their inaccessibility is an obstacle to success.

Little is known of the fishing resources from Yakutat to Cape Suckling. Several streams flow into the sea along this line of coast, but they are probably inaccessible. In 1889, when twenty additional canneries were built in Alaska, four were located in the vicinity of the Copper River Delta, but only two are now in operation.

LITTLE KAYAK ISLAND.

In 1889 a company known as the Central Alaska Company built a cannery on Wingham or Little Kayak Island (also known as Mitchell Island), about 15 miles west from Cape Suckling. The cannery made a pack of 1,600 cases that year, and the following spring it was moved to Thin Point, on the southern side of Alaska Peninsula. It operated during 1890 and 1891, and was absorbed by the Alaska Packing Association of 1892 and closed, and in 1893 it joined the Alaska Packers' Association, but was no longer operated. In 1895 the available machinery was moved to Koggiung, on the Kvichak River, in Bering Sea, and utilized as a part of the plant of the Point Roberts Packing Company.

The Peninsula Trading and Fishing Company built a cannery on Little Kayak Island in 1889 and packed 2,540 cases that year, and 14,200 cases in 1890. In the fall of 1890 and spring of 1891 it was moved to one of the sloughs of the Copper

River Delta, known as Coquenhena, and operated under its former name, making a pack in 1891. It joined the Alaska Packing Association in 1892 and was closed, but for some reason it did not join the Alaska Packers' Association of 1893. Since 1893 it has been operated by the Pacific Steam Whaling Company. A change in the channel of the slough has made it difficult of access, and the cannery was closed in 1897. The machinery has been removed, and it is said that such as is available will be installed in the new cannery built in 1897 at Kenai, Cook Inlet. It had a capacity of about 1,200 cases a day.

The Peninsula Trading and Fishing Company employed 40 white fishermen, 20 white cannery-hands, and 60 Chinese in 1896. Ten gill nets were used, each 100 fathoms long by 24 meshes deep, for king salmon, and 20 gill nets, each 200 fathoms long by 30 meshes deep, for redfish—all valued at $1 per fathom. The vessels employed by the company were the stern-wheel steamer *Thlinket*, of 30 tons, with a crew of 5, and valued at $10,000, and the launch *Beaver*, of 5 tons, with a crew of 3, and valued at $4,000. The ship *America*, attached to the Orca cannery, was used in transportation. Two lighters, valued at $200 each, and 20 Columbia River boats, valued at $200 each, were also operated.

The pack of 1896 was 20,558 cases of redfish, 10 to the case, from May 20 to July 25, and 114 cases of king salmon, 2.5 to the case, from May 20 to June 1.

ODIAK.

In 1889 Messrs. Louis Sloss & Co., of San Francisco, built a cannery under the title of Pacific Packing Company, at the extreme eastern end of Prince William Sound, on the mainland east of Hawkins Island and on the northern side of a mud slough separated from Lake Eyak by a narrow neck of land, about three-fourths of a mile wide, and now called Odiak. This cannery has been operated every year since except 1892, when it joined the Alaska Packing Association and was closed. In 1893 it entered the Alaska Packers' Association, and is now operated by that organization. It has a capacity of about 1,500 cases a day.

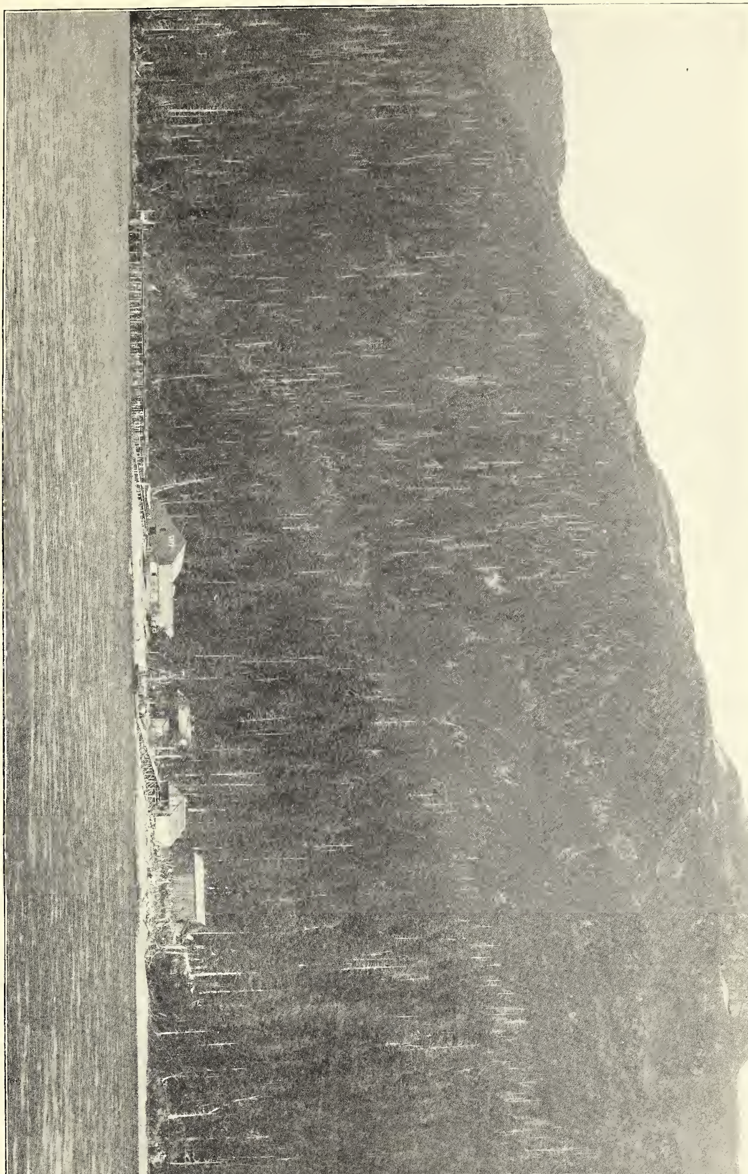
In 1897 the Pacific Packing Company employed 64 whites as fishermen, and 7 whites and 66 Chinese in the cannery. The nets used comprised 32 sets of gill nets, 450 fathoms per set, worth $1 per fathom—9½-inch mesh for king salmon, 6½-inch mesh for cohoes, and 6¼-inch for redfish. The vessels and boats employed were the screw steamer *Pacific*, 32 tons, crew 6, valued at $14,000; the stern-wheel steamer *S. B. Mathews*, 165 tons, crew 6, valued at $14,000; the stern-wheel steamer *Susannah*, 18 tons, crew 6, valued at $9,000; one lighter worth $250; 32 Columbia River boats worth $200 each, and 2 seine boats valued at $100 each. The ship *Centennial*, 1,139 tons register, worth $20,000, served as a transport, with a crew of fishermen.

The 1896 statistics for equipment were practically the same as for 1897, except that the chartered bark *Gatherer*, 1,377 tons, was used as a transport.

The following gives the statistics of the output of the Pacific Packing Company for 1896 and 1897:

Species.	1896.				1897.			
	Total number of fish.	Dates.	Cases packed.	No. of fish per case.	Total number of fish.	Dates.	Cases packed.	No. of fish per case.
Redfish	282,438	May 10 to Aug. 30	29,500	9.6	170,116	May 6 to Aug. 10	13,315	12.7
Cohoes	1,953	Aug. 9 to 27	217	9.				
Humpbacks	217,120	July 8 to Aug. 24	9,910	22.	239,430	July 5 to Aug. 8	9,784	24.5
King salmon	817	May 6 to June 14	216	3.8	995	May 6 to June 13	202	4.8

PLATE 50.



CANNERY AT ORCA.

The difference in the average number of fish to the case for the two years is due to waste. The number of fish received is the cannery count, and in the case of redfish, in 1897, a large number was rejected, and probably the same was the case with the humpbacks in 1896. When the pack of a species is small, the number consumed by the cannery-hands and salted, though counted as part of the catch, makes a large difference in the number to the case.

ORCA.

The Pacific Steam Whaling Company in 1889 built a cannery on the southern side of the same mud slough on which the Pacific Packing Company located at Odiak, and nearly opposite the latter company's establishment. In the spring of 1895 it was moved to a more salubrious site on the mainland, now known as Orca, east-southeast from the northern point of Hawkins Island, and about 4 miles north of its former location. This cannery has been operated every year except 1892, when it entered the pool of the Alaska Packing Association and was closed. It did not join the Alaska Packers' Association in 1893. It has a capacity of about 1,500 cases a day. In 1896, 60 white fishermen were employed, and 25 whites and 65 Chinese in the cannery. The Chinese contract was 42 cents per case, and in addition the tester received $40 a month and the boss $50 a month. Thirty sets of gill nets were used, 350 fathoms to the set, valued at $1 per fathom; mesh, 9½-inch for king salmon, 6½-inch for cohoes, and 6¼-inch for redfish. Three seines, each 150 fathoms long, valued at $1 per fathom, were also used.

The company, in 1897, employed 86 white fishermen and 17 whites (including a doctor), 6 natives, and 81 Chinese in the cannery. The fishermen used 43 sets of gill nets, 450 fathoms per set, 9½-inch mesh for king salmon, 6½-inch for cohoes, and 6¼-inch for redfish, all valued at $1 per fathom.

Three steamers were employed in 1897, the *Wolcott*, 199 tons net, crew 9, value $25,000; and the *Wildcat* and *Thlinket*, both stern-wheel, 50 tons each, crew 5 each, and valued at $10,000 each. The ship *America*, 1,909 net tons, with a crew of fishermen, was chartered. Two lighters valued at $250 each, 43 Columbia River boats at $200 each, and 3 seine boats at $100 each were also used. The equipment statistics were about the same in 1896 as for 1897, but only 30 Columbia River boats were used in 1896 instead of 43, and the steamer *Thlinket* was used by the Peninsula Trading and Fishing Company, and the *Wolcott* had not been purchased.

The following table gives the statistics of the pack of the Pacific Steam Whaling Company at Orca for 1896 and 1897:

Species.	1896.				1897.			
	No. of fish.	Dates.	No. of cases packed.	No. of fish per case.	No. of fish.	Dates.	No. of cases packed.	No. of fish per case.
Redfish	222,157	May 15 to July 31	23,445	9.5	201,371	May 13 to July 31	21,197	9.5
Cohoes	29,909	Aug. 13 to Sept. 14	4,021	7.5	25,605	Aug. 14 to Sept. 12	3,414	7.5
Humpbacks	91,060	July 9 to 26	4,855	18.7	62,860	July 9 to Aug. 5	3,415	18.7

A few king salmon were taken each year, but these were packed with the redfish. In 1896, 285 cases of redfish were packed in May, 13,785 in June, and the remainder in July. In 1897, 3,600 cases of redfish were packed in May, 14,486 cases in June, and the remainder in July. The cohoes are packed up to the closing of the cannery, and run much later, though not in paying quantities.

In 1896, 3,000 cases of redfish were taken in seines in Prince William Sound and the remainder in gill nets from the Copper River Delta. Of the cohoes, half were taken in seines and half in gill nets.

The Indians say that after the cannery closes there are plenty of fish.

The terms of the Pacific Steam Whaling Company with their fishermen are as follows: Of the number employed, 20 are paid $40 each for taking the vessel with the outfit from San Francisco to the cannery, and back in the fall with the pack. From the beginning of the fishing season until it closes, each fisherman receives $15 per month and board, and the cannery pays to each boat outfit (2 men) 3 cents each for redfish and cohoes, 10 cents for king salmon, and $5 per 1,000 for humpbacks.

Fishermen to make good wages should take 10,000 fish to a boat (2 men) during a season, and this catch was formerly quite frequent, but large catches are very rare now, and there is much complaint among the fishermen. In 1890, with 150 fathoms of web they could average from 7,000 to 8,000 fish to a boat, and now with 450 fathoms of web they barely average half that number.

As these two canneries at Orca and Odiak were built the same year, have operated during the same periods, and fish over the same localities, the remarks in reference to the fishing are applicable to both. The fish are taken in two entirely different sections, differing but little in distance, yet widely in their runs and fishing methods. The canneries are located on the dividing line separating the two sections and are accessible to both. Rounding Cape Whiteshed to the eastward extends the Copper River delta, which is the gill-net fishing-ground, similar to the fishing in the large rivers of Bering Sea, while to the westward extends Prince William Sound which represents the drag-seine fishing, a counterpart of southeast Alaska, with its many small streams, each affording a few fish.

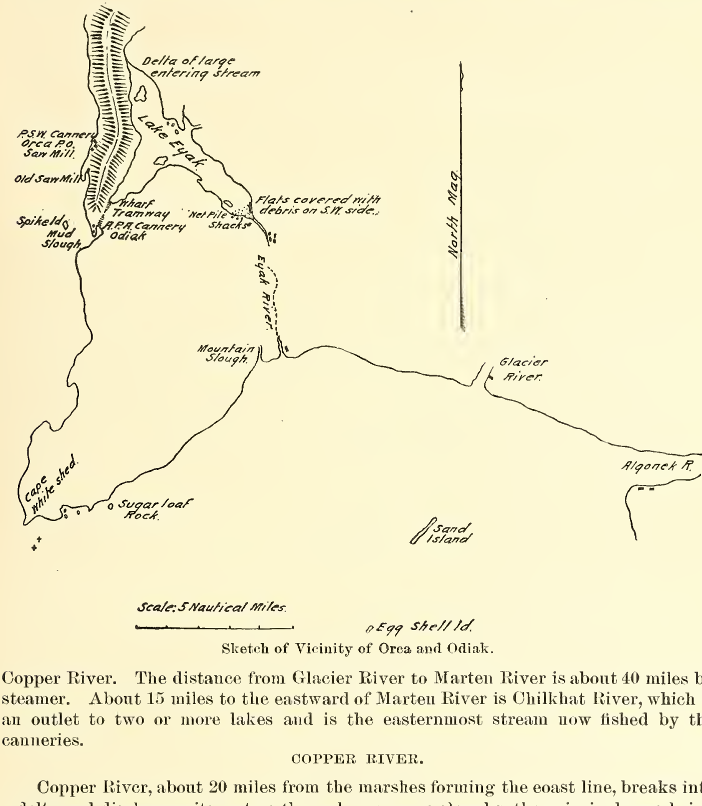
In 1889 the two canneries on Little Kayak Island drew their fish from the Copper River delta and the rivers in the vicinity of Little Kayak. In 1890, after the removal of the Central Alaska Company to Thin Point, the Peninsular Trading and Fishing Company made its pack from the same source. After its removal to Coquenhena, and until dismantled in 1897, its fish supply came from the Copper River delta.

The first pack, about 20,000 cases in 1889, was made by the two canneries at Odiak almost entirely from the lake and river at Eyak. In 1890 the fish were obtained from Eyak Lake and River, Mountain Slough, a branch of the latter, Glacier River, and Algonek Slough in the delta, and from Miner's River and Cheniga in Prince William Sound. As fish became scarce, fishing operations were extended as far eastward as Chilkhat River (not to be confounded with the Chilkat River at the head of Lynn Canal) a distance of about 75 miles by steamer; to the westward all the streams in Prince William Sound were reached, a run for the steamers of from 85 to 90 miles. The main source of supply, however, now comes from the Copper River delta, which includes Eyak River on the west and Chilkhat River on the east, though neither takes its source from the Copper River.

The great flats that make offshore between Point Steel and Kayak Island have no doubt been formed by the detritus from the Copper River, and are usually spoken of as its delta.

The first stream along the shore eastward from the canneries is Mountain Slough, an outlet or slough of Eyak River, having its mouth in the corner of the bight formed by the headland, of which Cape Whiteshed is the terminal point, and the mainland extending to the westward from Copper River. About a mile to the eastward is the

mouth of Eyak River, the main outlet to the lake; $5\frac{1}{2}$ miles farther east is Glacier River, and the same distance beyond is Algonek Slough, the first or western slough of Copper River. After that come Pete Dahl Slough, Big River, Coquenhena, Cottonwood Point, Little River, Gus Wilson Slough, and Marten River, all sloughs of



Sketch of Vicinity of Orca and Odiak.

Copper River. The distance from Glacier River to Marten River is about 40 miles by steamer. About 15 miles to the eastward of Marten River is Chilkhat River, which is an outlet to two or more lakes and is the easternmost stream now fished by the canneries.

COPPER RIVER.

Copper River, about 20 miles from the marshes forming the coast line, breaks into a delta and discharges its waters through numerous sloughs, the principal ones being those just mentioned. The tide ebbs and flows for a long distance through the sloughs, and they not only receive the river and tidal waters, but in addition those sloughs bordering the highlands and mountains receive the discharges from small lake outlets and glacial streams. It is probable that few except king salmon ascend a great distance up Copper River proper, finding their spawning-beds in the lower tributaries. Bordering the delta, and as far as Point Steel on the west and Kayak on

the east, are great sand and mud flats extending from 3 to 6 and more miles from the shore and marshes. Most of these flats are dry at low water, but they have channel-ways through them seaward from the larger sloughs, and shallow channels and pools between them which admit the passage of light-draft stern-wheel steamers. It is probable that Copper River originally discharged into a large irregular bay, which gradually filled and formed the present delta, and the flats outside are merely the foundations for its farther expansion seaward.

The conditions here admit gill-net fishing only, which is done by drifting with Columbia River boats, 2 men and 450 fathoms of web constituting an outfit. There are stations or bunk-houses at different points within the sloughs, where the fishermen live and from which the catch is taken to the canneries by the small stern-wheel steamers calling for them. These steamers, of which there are two at each cannery, have a draft of 24 inches and navigate the shallow waters of the delta. At low water they are frequently aground.

The king salmon packed at the canneries are obtained in the delta, and commence to run about May 6; scattering ones are taken all summer. While this pack has never been very large, the catch has decreased rapidly during the past few years, and to such an extent that in 1896 some of the interior Indians were reported to be on the verge of starvation on account of this scarcity of king salmon, which forms a large item of their food. In 1897 there was great rejoicing among the Stick Indians when they heard that the cannery at Coquenhena would not be operated. It seems hardly probable, in a locality where the natural conditions permit only fishing by gill nets, that the fishermen should have caused this decrease, yet it is said that the nets are placed at such short intervals that they lie almost back to back and side by side.

The following catches of king salmon, from the books of the Pacific Steam Whaling Company, show the number taken per year by one cannery:

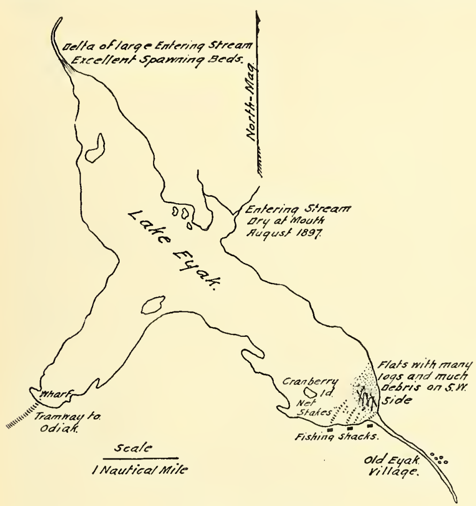
Year.	Dates.	Number.	Year.	Dates.	Number.
1890	May 5 to June 30	5,491	1894	May 11 to June 30	4,494
1891	Apr. 27 to June 30	6,185	1895	May 8 to June 29	5,929
1892	Closed		1896	May 15 to June 30	590
1893	May 2 to June 30	8,674	1897	May 10 to June 30	1,049

The mud slough on which both canneries were originally located is less than half a mile in length and inaccessible at low water. During the packing season, when the mud banks are covered with salmon offal and refuse, they become very foul, and were it not for the myriads of gulls which act as scavengers, it is difficult to see how any one could live in the locality.

Three-fourths of a mile distant from the cannery at Odiak, in a general northeast direction over a low neck of land, is the head of the southwest arm of Lake Eyak. A tramway from the cannery extends to this point and terminates on a small wharf on the lake shore. The lake is T-shaped; that is, there are three arms, each widening toward the junction and extending in northwest, southwest, and southeast directions respectively. These arms are about 2½ miles long with an extreme width of about a mile, with the main body or junction much enlarged. The shore line is rocky, the banks are heavily wooded, and in places are high and steep where they run directly into the mountain masses. There are many places which are quite shallow, rocky in some instances, and with gravel and sand bottom in others. The surface of the lake is on a level with the highest tide; indeed, tide water sometimes backs into the

lake. It is fed by a number of cascades and streamlets, with one large, rapid stream discharging through a delta at the head of the northwest arm, and a small stream, which during the dry season loses itself through the marsh and gravel, on the northeast side of the lake directly opposite the southwest arm. At the western side of the southeast arm is the lake outlet. It flows in a general south and southeast direction for a distance of from 5 to 6 miles, with a width of 200 feet, emptying into the sea on the western side of the delta of Copper River.

The banks of the outlet (Eyak River) are generally rocky, with projecting, wooded ridges, though in places they are of clay, and grassy. The current at low water is strong, but at high water slack, and at the highest tides it is an inflowing stream. About 3 miles from the lake the river receives from the eastward the whitish waters of a glacial stream of considerable size, and below this point a slough, before referred to as Mountain Slough, opens from the main river and carries some of the water in its own channel, discharging about a mile to the westward of the river.



Sketch of Lake Eyak.

For several years Eyak River and Lake formed a highway for lighters and the smaller vessels engaged in transporting fish from the delta. They were carried direct to the wharf at the head of the southwest arm, and thence shipped by tram to the cannery. It was found more economical, however, to run the steamers around Cape Whiteshed, direct to the canneries, and no fish, except those carried by small boats, are now transported by way of Eyak Lake and River. The newer stern-wheel steamers have been built much larger, and it would be hazardous to use them on the former route.

The large entering stream at the head of the northwest arm of the lake discharges its whitish snow, or glacial waters, into the lake through a delta in which the larger streams are from 25 to 35 feet wide, and several feet deep, flowing with a rapid current over sandy and pebbly beds; the banks are pebbly, bare in some places, covered with grass in others, and the growth of trees and shrubs increases as the streams are ascended. It seems an ideal spawning-ground, vast in extent, and with abundance of water, yet very few salmon were seen. The party, perhaps, did not ascend high enough to find the actual spawning-beds, but in any event there should have been large numbers of dead fish encountered; not above a dozen, however, were seen, only enough to show that they do go there. Possibly the water is too cold, yet the

few fish seen would indicate that it is not, and this scarcity of salmon may be owing to the wanton fishing of the lake. On the northeast shore is a small stream which, during the time of our visit, had no flow of surface water; large pools stood in the gravelly bed. Around the mouth a few dead fish were seen; in fact, the lake nowhere showed an abundance of salmon.

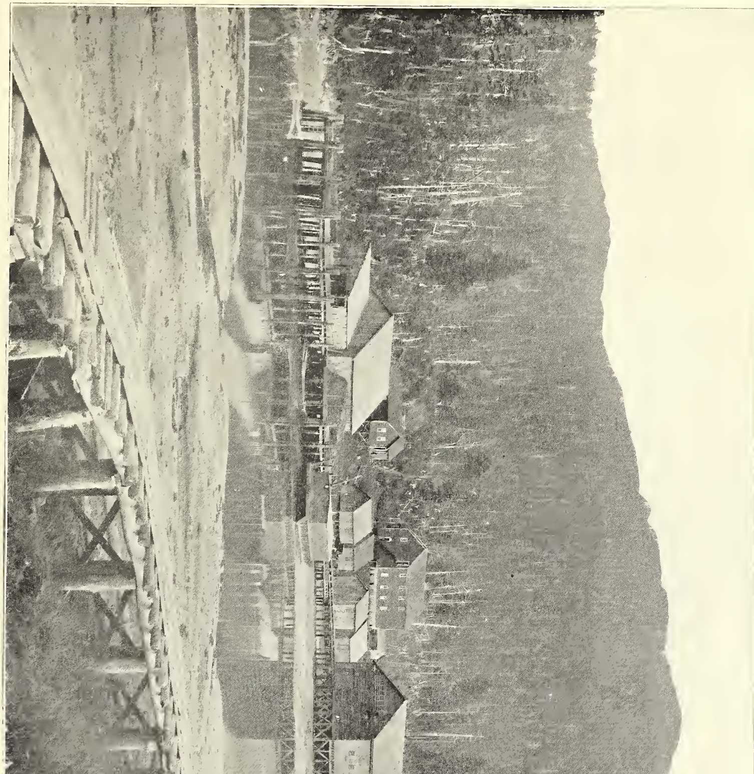
On the western bank of the southeast arm of the lake, near the outlet, is an Indian's shack, and at the time of our visit a number of Indians were smoking and drying humpbacks and cohoes. Below the shack is a rather neat log cabin with drying racks for nets around it, and a short distance beyond is a board fishing-hut used for storing nets. In different parts of the lake stakes were projecting above the surface, and near the outlet they were especially numerous, their use being quite evident. Across the outlet at the lake and back for a distance of nearly half a mile were lines of heavy stakes running across the channel, to which gill nets are secured. These nets form an almost impassable barrier, and the wonder is that any fish ever

Fish-wharf on Lake Eyak.

get through to the spawning-grounds. Upon the arrival of the vessel no nets were found, but a few days before my visit an Indian trader from the Copper River district came to Orca for his winter-trade stock; he said in passing this point—the head of the outlet—the nets were so thick he thought he would have to cut them in order to gain a passage for his boat.

LAKE EYAK.

Lake Eyak has been fished every year since the canneries have been in operation. The first year's pack was almost entirely from this source; but from a locality once good for 200,000 redfish—some say 250,000—it has dwindled down to 11,000 in 1897. Fishermen think that if the lake and river were not fished, the approaches to the mouth could be made to yield 25,000 redfish in a short time.



CANNERY AT LAKE EYAK.

From Lake Eyak the outlet flows a straight course for a mile in a south-southeast direction, and then turns about 1 point to the eastward. In this slight bend, on the left bank, the old native village of Eyak was located. It is now practically abandoned, the inhabitants having moved to Odiak, where they live in shacks and log-houses scattered along the line of the tramway. Quite a number of white men who fish for the canneries remain in the country all winter, not only here, but in Cook Inlet, Kadiak Island, and elsewhere, but there seem to be more here than at other places.

It is said that a few salmon are obtained by the Indians in Lake Eyak during the winter months. The water being very cold, it is probable that the cohoes do not spawn until very late, and the Indians may catch these fish, or possibly a few steelheads may run here at this time.

The natives in all parts of Alaska and the Aleutian chain prefer the fish well advanced toward spawning for their winter supply. In a country where the natives use rancid seal oil as a sauce for all delicacies, including strawberries and salmon berries, and bury salmon fresh from the sea for ten days or more to make them thoroughly ripe and palatable, and where a putrid whale carcass furnishes the choicest tid-bits, a salmon well-ripened under natural conditions might be thought the proper food to prepare for winter. The idea is, however, that when taken from the spawning-ground they are in poor condition from long fasting, and have very little fat or oil, so that the drying or smoking process is hastened.

PRINCE WILLIAM SOUND.

It is very difficult, in the absence of charts or maps, to describe the fisheries of this section. Time permitted only a survey of the waters in the vicinity of the canneries. The waters are entirely unsurveyed, extend over a large area, and are not well known. Chart B may give some idea of the situation.

The Copper River Delta, as before mentioned, is the principal source of fish supply for the canneries; the fish from Prince William Sound are simply an addition, and the total catch for all its streams would support only a very small cannery. The information regarding the streams of Prince William Sound was obtained from the cannery superintendents, masters of cannery steamers, and fishermen, modified somewhat by carefully examining records whenever there was opportunity.

The salmon streams of Prince William Sound resemble those of southeast Alaska, although as a rule they are inferior. The total catch for the whole district does not equal the catch of such streams as Quadra, Hetta, and others in a good season, and probably does not average over 125,000 redfish and 50,000 cohoes per season. The Pacific Steam Whaling Company's cannery has never exceeded 32,000 redfish and 35,000 cohoes per season from the sound. While there are many streams that contain humpbacks, they are not very plentiful in any one stream. In none do they run even as they do in the smaller streams of southeast Alaska, and they, as well as the redfish and cohoes, are decreasing yearly. In short, the district is poor in salmon, and the streams have been injured by injudicious and illegal fishing.

Nor are the canneries the only drains upon the salmon streams. The Treasury Department has leased certain islands in Prince William Sound and along the Alaska Peninsula to individuals and organizations for the purpose of breeding foxes, and thousands of salmon are cured annually for fox food.

The canneries at Orca and Odiak alone fish and have fished the streams of Prince William Sound for commercial purposes. Until 1897 they had a mutual agreement by which the streams of the sound were equally divided, and neither encroached upon the other's territory. In 1897, however, each cannery fished wherever it felt disposed.

STREAMS OF PRINCE WILLIAM SOUND.

After leaving Orca, rounding Hawkins Point, and passing through the narrows, on the starboard hand a large bay is seen making in to the northeast, known as Simpson Bay. It has several small arms and a few streams which combined are good for about 1,000 redfish, 2,000 cohoes, and a few humpbacks.

The next bay to the westward, making in to the northern shore, is known as Sheep or Jackson Bay. It has several humpback streams.

Next in order to the westward is a large bay known as Port Gravina, which is a deep indentation with several arms. At the head of the main body is a large stream which in good seasons will produce about 25,000 cohoes. There are two streams on the eastern side and three on the western side, all containing humpbacks. There are no redfish streams in the bay, but redfish sometimes school around the grassy flats on the western side. It is reported that the stream at the head of the bay is barricaded.

In Port Fidalgo are three humpback streams, and one of them also yields about 5,000 cohoes a year.

In Port Valdes are also three streams containing humpbacks, one of which carries cohoes.

Inside of Glacier Island is a stream known as Billy's Hole, from which in some years 20,000 redfish have been taken.

The next deep body of water westward is Salmon Sonnd, on the eastern side of which is Miner River, good for about 10,000 redfish. It is the outlet of two lakes, has been fished since the first year after the canneries were started, and has been continually barricaded. On the eastern side of Port Wells, inside of Esther Island, is a small stream which is also barricaded. It is capable of producing 3,000 redfish per year.

North of Point Nowell, and inside of an island and a line of reefs, is a small stream known as Rubber Boot, which can be relied on for about 3,000 redfish annually. It is barricaded.

Cheniga is between Rubber Boot and Point Nowell and has the largest run of redfish in Prince William Sound. In 1895 it furnished about 100,000, but a safe value is 50,000. It is said to be heavily barricaded.

Jack Pot is a stream that empties into the head of the third inlet southwest from Point Nowell. It is the outlet to a large lake system and can produce annually about 7,000 redfish.

Somerset River, on the eastern side of Knight Island, is a small stream. A few thousand redfish may be obtained from it annually.

Port Bainbridge has at its head an outlet to two lakes. The outlet carries redfish, but the product obtainable is unknown.

This completes the list of known salmon streams in Prince William Sound. As the cannery people are constantly striving to increase their packs, the steamers have prospected the locality very thoroughly, and it is believed that all the salmon streams of any value are known. The runs of fish are very uncertain, and as they vary largely from year to year, data of material value can not be obtained. No regular fishing

crews are kept at the distant points; a stream is visited by a steamer and crew, and if fish are found schooling, the crew remain as long as a catch is made, visiting another locality if no fish are found.

Except Cheniga, the streams are all said to have small runs, and the pack of Prince William Sound fish is small. Fishing is done entirely by seines, but any and every device is used that will facilitate the catch. Fishermen and others interested do not deny that the streams are barricaded. The law exempts Prince William Sound from the weekly close season. Why this and some other places should be exempt is not understood, but from all reports one would also fancy that the sound was exempt from the provisions against barricading.

The following data were made up from the cannery books at Orca, and represent the runs of redfish and cohoes in Prince William Sound in numbers large enough to warrant fishing. A few run earlier and later, and in the case of cohoes it is probable that they run in considerable numbers after the cannery closes.

Year.	Redfish.		Cohoes.	
	Commenced running.	Finished running.	Commenced running.	Finished running.
1891	June 16	July 13	Aug. 4	Sept. 14
1892	Cannery closed.		Cannery closed.	
1893	July 1	No data.	Aug. 10	Sept. 15
1894	June 30	July 18	Aug. 14	Sept. 4
1895	June 21	July 7	Aug. 19	Sept. 1
1896	July 7	July 25	Aug. 13	Sept. 9
1897	July 11	Failure this year.	Aug. 11	Sept. 9

From Prince William Sound to Cape Elizabeth, the end of what is designated as the second district, there are no fisheries. There are very few inhabitants in this region, and little is known of its features. No streams having large numbers of salmon are known to exist anywhere in this vicinity, otherwise canneries would be established. The large bays on this broken and rugged coast probably receive the waters of numerous streams draining mountain slopes and glaciers, and all may carry some salmon. Future investigation alone can determine their commercial value.

COOK INLET DISTRICT.

This district extends from Cape Elizabeth to Cape Douglass. All the canneries that have been operated in Cook Inlet have been located on the eastern shore at two points, Kenai and Kussilof. In 1891 three canneries were in operation, but since that date only one.

The climate of Cook Inlet runs to extremes in the different seasons. The summers are comparatively mild and sunny, and the winters very cold, the extreme temperature reaching 60° below zero over the surrounding country. Across the Kenai Peninsula, in Prince William Sound, the summers are wet, and in the winter extreme cold is not experienced.

The Cook Inlet district is a very difficult one to fish. There are probably plenty of salmon to supply several canneries, but they are not only difficult to catch, but the fisheries and the conditions attending the serving of the canneries are extremely hazardous. The tides and currents in the inlet are strong and treacherous, increasing in height and force as its head is approached, where the tide comes in with a bore which is extremely dangerous to small craft. Nearly every season some lives are lost in the swift currents of Cook Inlet. The whole section is unsurveyed. Shoals make out a long distance from the shore, and are continually changing. When the cannery people return in the spring of the year they find the shoals and flats are much changed, and bowlders—sometimes of very large size—are noticed where they were not before, having been brought down by the large ice floes.

As frequent allusion is made to the very large king salmon taken in Cook Inlet, it may be mentioned that in 1897 the largest individual salmon ever known in the vicinity was caught at Kussilof; it weighed just 68½ pounds, and lost 21 pounds in dressing. It is said the flesh of the coho is a deeper red here than at other places, and there is a marked difference between the large and small redfish, the latter being much rounder.

The average pack of this district since 1882 is 6.5 per cent of the Alaska pack, and for 1897 it is 3.6 per cent.

KAKNU RIVER.

Kaknu River takes its source from Lake Skillokh, on the western slope of the Kenai range of mountains, and flows in a westerly direction for about 40 miles, emptying into Cook Inlet at Kenai, some 12 miles north of Kussilof. The river is said to have some large tributaries, and as a salmon stream has a greater value than the Kussilof. The cannery at Kussilof has three traps in this vicinity during the fishing season. The superintendent of the cannery, when asked as to the value of the two streams, said that they were both very uncertain; that the Kussilof ranged from nothing to 5,000 cases, and the Kaknu from 3,000 to 10,000 cases. The fish here average about 14 to the case. The Kaknu is undoubtedly the better stream, but the impression prevails that neither can be depended upon, and that it is exceptional to have a big run. Another authority stated that the Kaknu was good for 150,000 fish.

Kenai was a place of considerable importance in the earlier days. The Redoubt St. Nicolas, a stockaded post, was established by the Russians in 1789 and several trading

SALTERY AT HEAD OF UGANUK BAY, KADIAK ISLAND.

REAR VIEW OF CANNERY AT KUSSILOF, COOK INLET.

companies have been operated at this place. At present there is a small settlement of about 150 inhabitants.

The cannery of the Northern Packing Company was built in 1888 on the eastern side of Cook Inlet, at Kenai, at the mouth of the Kaknu River, 51 miles above Anchor Point. It was operated in 1888, 1889, 1890, and 1891. In 1892 it joined the Alaska Packing Association, and it became a member of the Alaska Packers' Association in 1893. It has been closed since 1891, and some of the machinery has been utilized in the plant at Kussilof, but it is said that the cannery is in such condition that it can be placed in running order at short notice. It is held as a reserve, and has a capacity of about 800 cases a day.

Buildings were completed for a cannery by the Pacific Steam Whaling Company at Kenai in the summer of 1897, near the cannery of the Northern Packing Company, but no machinery was installed. It was said that the machinery of the Coquenhena cannery was to be placed in this plant in the spring of 1898, and the cannery was to be operated that season. It will have a capacity of about 800 cases a day.

KUSSILOF RIVER.

The Kussilof River has its source in Lake Tustumena, a large body of water on the western slope of the mountain range that forms the dividing ridge on Kenai Peninsula, and flows in a general westerly direction through bottom lands and timber for about 25 miles, emptying into Cook Inlet at Kussilof. It is said that the lake is fed by bottom springs and small streams. The river receives several tributaries, some of which are lake outlets. Little accurate information can be obtained of these waters. Hunters penetrate the interior after moose, mountain sheep, and bear, but their reports are vague and conflicting. The rise and fall of spring tides at Kussilof is over 30 feet, and tide water extends up the river for a distance of 6 miles, to a point where the first rapids are encountered. At low water the stream runs some distance into the inlet between high mud banks, with a bar at the end, which is bare at spring tides. The cannery is on the right bank, with some buildings on the river and some on the inlet. The river at this place is about 150 yards wide.

The superintendent of the cannery stated that all their fish were taken in the inlet, and that the rivers were not fished at all, as fish were not numerous enough to justify making preparation for them. He said that a number of years ago, before there was any law on the subject, he built a trap in the river proper, which took only 20,000 fish during the entire season.

In 1890 Mr. George W. Hume, of San Francisco, built a cannery at Kussilof on the right bank of the river, about half a mile above its mouth. It was operated in 1890, 1891, and 1892. In the latter year it joined the Alaska Packing Association, in 1893 it entered the Alaska Packers' Association, and in 1894 it was consolidated with the Arctic Fishing Company's plant. It has not been operated since 1892.

In 1882 the Alaska Packing Company, of San Francisco, built a cannery at Kussilof, on the right bank of the river at the mouth, utilizing in its construction the available machinery of a cannery built at Old Sitka by the Cutting Packing Company, of San Francisco, in 1878.* In 1885 this cannery was sold to the Arctic Fishing Company. In 1890 the cannery ship, the *Corea*, was wrecked in Cook Inlet, and the cannery was not operated. In 1892 it joined the Alaska Packing Association and

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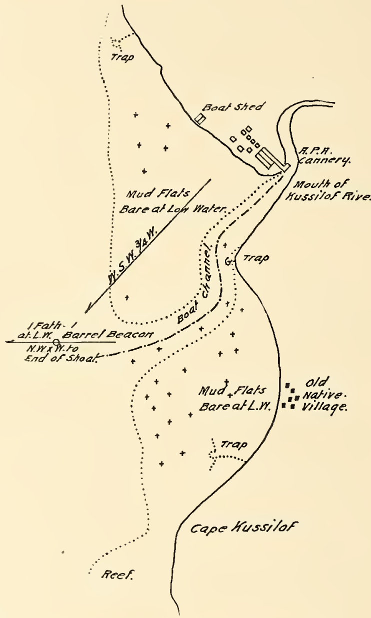
* The Old Sitka cannery made a pack in 1878 and 1879 and was then closed.

was closed, and in 1893 it entered the Alaska Packers' Association, and has been operated by that organization to the present time.

In 1897 the Arctic Fishing Company employed 35 white fishermen, and in the cannery 8 whites, 20 natives, and 100 Chinese. The fishermen used for redfish 15 gill nets, each 50 fathoms long, $6\frac{1}{4}$-inch mesh, 30 meshes deep, valued at $1 per fathom; also for king salmon, 15 gill nets, each 50 fathoms long, $9\frac{1}{2}$-inch mesh, 22 meshes deep, valued at $1 per fathom; 8 pile and web traps, 30 feet by 50 feet square pots, and leaders 300 to 700 feet long, valued at from $300 to $1,500 each. Three steamers were employed—the *Jennie*, of 70 net tons, with a crew of 6, and valued at $26,000; the *Olga*, of 8 tons, with a crew of 2, and valued at $6,000; the *Arthur*, of 5 tons, with a crew of 2, and valued at $2,100. The chartered bark *Prussia*, of 1,131 net tons, and with a crew of fishermen, was used as a transport. Three sloop lighters worth $400 each, 1 pile-driver worth $750, 1 coal scow valued at $500, 15 gill-net boats at $50 each, and 6 trap scows at $50 each, were also employed.

In 1896 the equipment was practically the same as for 1897, and the same hands were employed.

The Chinese contract of the Arctic Fishing Company was $42\frac{1}{2}$ cents a case. The fishermen received board, $30 a month, and $\frac{3}{4}$ cent a case. A number of these men remain in the country during the winter, and hunt and trap; some are squaw men. The cannery ship remains at anchor in Tuxedni Harbor, under Chisick Island, on the western shore of the inlet, as the anchorage off the cannery is unsafe.



Sketch of Kussilof River and Vicinity.

The following gives the pack of the Arctic Fishing Company at Kussilof River for 1896 and 1897:

Species.	1896.				1897.			
	Number of fish.	Cases packed.	Fish per case.	Dates.	Number of fish.	Cases packed.	Fish per case.	Dates.
Redfish	309,863	23,367	13.2	May 25 to Aug. 14	354,800	24,701	14.1	May 25 to Aug. 12.
Cohoes	27,600	2,300	12	July 20 to Aug. 10	28,000	2,313	12.1	July 20 to Aug. 12.
King salmon	18,076	7,000	2.6	May 25 to June 25	14,083	5,518	2.5	May 26 to July 27.
Humpback	37,800	2,100	18	July 15 to Aug. 10	....	....	....	

This cannery commences to pack when the ice leaves the inlet so that the nets and traps can be used, usually about May 25, and closes about August 14. The first catch consists of king salmon and redfish, the latter in small numbers, but the combined product is sufficient to yield 50 to 100 cases a day. By July 1 the cannery generally has a pack of 8,000 to 9,000 cases, of which two-thirds are king salmon and the rest redfish. During July they expect to pack from 19,000 to 25,000 cases, of which 2,000 cases are king salmon, 2,000 cases cohoes, the remainder redfish; in August, to the 14th, they count on from 2,000 to 4,000 cases, nearly all of which are cohoes.

The height of the run of the different species is as follows: King salmon, from June 10 to 27; redfish, from June 1 to July 25; cohoes, from July 20 until after the cannery closes; and humpbacks from July 15 to August 10.

The cannery conducts all its fisheries, using traps and gill nets. The gill nets are used in the inlet by drifting in the strong tidal currents—on the eastern side from Anchor Point to the East Foreland, and on the western side from Kalgin Island to Tyonek (see Chart B). The current is very strong, so that the boats drift rapidly. The water is not clear.

Five traps are used in the vicinity of Kussilof and three near Kenai. They are built in the usual way, with long leaders from the shore to deflect the fish into the square or heart at the end, which is in deeper water. They are driven in the spring and pulled up when the cannery closes, as no piling would stand the ice which moves in great masses in the inlet during the spring.

The records of 1896 may give a general idea of the relative value of gill nets and traps in Cook Inlet. Of king salmon, 33 per cent were taken in traps and 67 per cent in gill nets; redfish, 87 per cent in traps and 13 per cent with gill nets; cohoes, nearly all in gill nets; humpbacks, nearly all in traps.

OTHER LOCALITIES IN COOK INLET REGION.

Mr. C. D. Ladd operates a saltery a short distance above Tyonek. About 100 barrels for local use would represent the total output in 1897.

On the western shore, below Tyonek, three streams of considerable size are said to empty into Cook Inlet. These streams are no doubt known to the cannerymen, as the gill-net fishermen drift their nets from Kalgin Island to Tyonek. The fish value of the district is fairly well known, except in Kamishak Bay, which is difficult of access and is reported to be foul and dangerous to navigate.

Two large rivers empty into Cook Inlet on the northern shore beyond the North Foreland—the Shushitna and the Knik; the former runs redfish and the latter king salmon. Very little is known of these localities.

THE KARLUK AND CHIGNIK DISTRICT.

EXTENT AND CHARACTER OF THE REGION.

This district extends from Cape Douglas to Unimak Pass and includes the canneries on Kadiak and Afognak islands, Chignik Bay, and Thin Point. From Cape Douglas along the southern shore of the Alaska Peninsula to Chignik Bay the coast is rugged and deeply indented, with high mountain masses impinging close upon the shore. Nearly all of these indentations probably receive streams that have salmon runs, but few of them are known to have redfish in numbers sufficient for commercial purposes. The canneries on Kadiak have prospected over this section and at times have sent a steamer to Kukak Bay and obtained a load of redfish. The canneries in prospecting, or on information from the natives, will locate one or two men on a stream for a full season and provide them with means for salting, judging the value of the stream from their output and their report. The only canneries that have been operated in this locality from Cape Douglas to Chignik have been on the islands of Kadiak and Afognak. The bulk of the packing has centered around the mouth of Karluk River, on the northwest side of Kadiak Island, in latitude 57° 36′ north, longitude 154° 17′ west, where more salmon are taken than at any other one place in Alaska.

The output of this district during the past sixteen years represents 43.8 per cent of the total Alaska pack, Chignik furnishing 8.1 per cent. The percentage has fallen off during the past few years, owing not so much to a reduction in the pack as to the increased output of southeast Alaska and Bering Sea.

During the summer of 1889, in accordance with an act of Congress directing the United States Commissioner of Fish and Fisheries to investigate "the habits, abundance, and distribution of the salmon of Alaska, as well as the present condition and methods of the fisheries," a party composed of Dr. Tarleton H. Bean, Mr. Livingston Stone, Mr. Franklin Booth, and Mr. R. E. Lewis spent the entire season on the islands of Kadiak and Afognak. The report upon their investigations is given in the Fish Commission Bulletin for 1889.

KARLUK.

Commercial fishing for salmon has been carried on at the mouth of the Karluk River for the past thirty years. The first cannery was built in 1882; previous to that a few hundred barrels of salt salmon were annually put up. The earliest account of commercial fishing dates back to 1867, when three parties were engaged in salting salmon. In 1870 the Alaska Fur Trading Company and the Alaska Commercial Company began to salt salmon—at first only to a limited extent, the output gradually increasing from year to year. From this small beginning grew the present great industry.

Prior to 1880 no record was kept of the salmon taken. In that year fishing commenced June 15 and ended September 22. The output amounted to 800 barrels of salt salmon and 100 half-barrels of salted salmon-bellies. The species taken was probably the red salmon (*Oncorhynchus nerka*).

The catch at Karluk in 1895 was approximately 1,762,000 redfish, in 1896 it was 2,650,000, and in 1897 it was 1,867,000. The canneries usually count on packing

GENERAL VIEW OF KARLUK, KADIAK ISLAND, SHOWING SPIT, RIVER, LAGOON, AND VILLAGE.

150,000 cases, which would take 1,800,000 redfish, and this is probably a fair estimate of the present capacity of the locality. It is generally believed, even by those interested, that there is a gradual decline, though they still run in large numbers. In 1896 several hauls on Karluk Spit yielded 75,000 salmon to the haul. Hauls of from 25,000 to 30,000 fish are not unusual during the height of the run. It is said that some years ago 100,000 salmon were taken at a single haul on the spit.

The fish are rather small; the general average is probably 5½ pounds in weight. In 1896 and 1897 the average number to the case was 12 fish; in 1897 it commenced at 17 to the case, changing to 15, and at the time of our visit, August 3 to 6, it was 13 to the case. The first run of the season usually consists of very small fish.

KARLUK RIVER.

The mouth of the outlet is in the middle of a curve in the shore line on the northwest side of Kadiak Island, facing Shelikof Strait, forming an open roadstead terminating on the west in a precipitous mountain mass, about 1,600 feet high, called Karluk Head, and on the east in a line of cliffs from 600 to 800 feet high. To the eastward of this so-called river mouth is a narrow shingle spit or bulkhead, making from the cliffs on the east, and closing what was once undoubtedly a narrow bay or estuary, forming it into a lagoon, of which the so-called mouth is but the outlet. On this shingle spit four canneries have been located at different times, but only three are now operated. The spit is three-fourths of a mile long with an average width of about 200 feet, the narrowest part being at the northeast end, where it joins a grassy bluff. The general direction of the spit is northeast and southwest. At the southwest end the outlet empties into Shelikof Strait.

The outlet is 90 feet wide at its mouth, and at times, during a heavy storm from the north or northeast, it shifts considerably, sometimes 50 feet or more. The sea, when it encroaches on the end of Karluk Spit, does little or no damage, but when the opposite bank is heavily washed during the gales of winter the foundation upon which the Alaska Improvement Company's cannery stands is threatened.

The top of the spit is composed of pebbles and coarse gravel; at the water's edge small bowlders appear, and 100 feet or more below low-water mark bowlders of considerable size are strewn over the bottom. When fishing was first commenced off the outside of the spit a large amount of work had to be performed in removing the bowlders before the ground was suitable for making hauls with the drag seine.

Karluk River has its source in two lakes situated about 16½ miles in a direct line from its mouth. The larger lake is about 8 miles long, the smaller 3 miles long. For a distance of several miles the river flows in a west-northwest direction. The mouth of the river proper is 2 miles above the canneries, at a point immediately northeast from the hatchery, where the stream flows rapidly over a bowldery bed and then spreads out into the lagoon (previously referred to) which is slightly affected by the tide.

This lagoon has at the head a width of about 300 yards, and gradually widens until it is nearly half a mile across as it approaches the spit. It suddenly contracts near the end of the spit and the southern shore, and at the outlet, at the point of the spit, it has a minimum width of about 90 feet. The lagoon has a general east-and-west direction, is about 2 miles in length, and, except for the shingle spit which is thrown across its mouth by the action of the sea, its shores are bluff, rising from about 50 to 100 feet. Through the narrows of the outlet the water runs as a rapid at low water, and on the inside the waters are not affected by the tide until the last 3 to 6 feet

rise on the high water. Boats can enter the lagoon only after half tide. About half a mile from the mouth of the outlet is a marshy island, which is the end of a large flat making out from the southern bluffs, and which has the greater part bare at low water. The lagoon is shallow, with sandy and grassy bottom and deeper holes along the spit and the northern shore. There is a shallow, regular channel at low water, and with difficulty a flatboat can be worked through. At the upper end of the lagoon the water is slightly brackish and the current flows out; the tide affects it by backing up about 18 inches.

The lagoon generally freezes over in the latter part of November, and as a rule does not break up until late in the spring. In the river, above the lagoon, and at the head of the latter, small bowlders, probably brought down by the ice, are scattered along the banks. It is said that the lakes at the head of the river frequently freeze over, and in an extremely severe winter it is claimed that they freeze to the bottom. The theory is advanced that when the lakes are frozen to the bottom it accounts for the small run of salmon at almost regular intervals.

FISHING-GROUNDS OF THE KARLUK REGION.

The waters surrounding the outlet to Karluk Lagoon are probably the most remarkable in salmon production in Alaska, not only in point of numbers, but in the length of the runs. The fish are principally redfish (*Oncorhynchus nerka*), but stragglers of all the other species are taken, and in some years the humpbacks come in immense numbers. One instance is recorded in which they were so thick in the outlet that a boat could not be pulled through them, and this condition prevailed for weeks. (See Dr. Bean's report.)

When salmon were taken for salting purposes only, and for some time after canneries were introduced, the fishing-ground for Karluk was in the outlet and lagoon, from $\frac{1}{4}$ mile to 2 miles from its mouth. It was not necessary to go outside, for an abundance of salmon could always be taken near the saltery and cannery. So numerous were they that by a few hauls, with a seine only 40 fathoms long, enough fish could be caught to supply the cannery for a day. On starting out in the morning fishermen were instructed to catch no more salmon than could be handled during the day. Seldom did they fail to bring in the required amount; the chief obstacle in the way was to devise means to take care of the salmon as fast as caught. This was no easy task, for fish were plentiful, the cannery small, and everything connected with it crude, having few of the appliances now in common use. The workmen, as compared with those of to-day, were unskilled and did not move with the speed and expertness now displayed. In a few years, however, it was found that larger nets and a greater number of them had to be used in order to compete with new canneries.

Up to 1889 fishing had been confined to the river, but even this wonderfully prolific stream could not long supply the demands of three canneries, and soon a perceptible falling-off in the daily catch was noticed. Before the season ended all the canneries were taking a large portion of their fish outside the mouth of the river. River fishing was not wholly abandoned, but the major portion of the catch came from the outside fishing-grounds.

The canneries at Karluk are chiefly, but not entirely, supplied from the fisheries in Karluk Bight. A few fish are taken in the vicinity of Red River and Ayakulik, on the western side of the island, a few miles south of Seal Rocks; also off the Slide, the bluff next east of the spit; from the Waterfalls, about 3 miles to the eastward of

Karluk, where two streams fall in cascades over a bluff; and from Northeast Harbor, a small indentation a few miles eastward of the Waterfalls; but these fish all belong to the Karluk school. Some years ago a few were taken at Little River, which is inside and a little westward of Cape Ugat, and from Kaguyak and Kukak, on the mainland. But all these places supply but a very small percentage of the Karluk pack. Occasionally, when there is a slack in the run at Karluk, one or the other of these places may be visited by the cannery steamer. Before the cannery at Uganuk was built the stream at this place was also fished by the Karluk canneries.

TIME OF THE SALMON RUNS.

The time of run is no less remarkable than the numbers of fish. The canneries count for a certainty on obtaining fish from the middle of June to the middle of September. Some years the packing has commenced the latter part of May, and again it has continued into October. Some cannerymen state that the Karluk packing season is from June 1 to September 30. It is true that the records show long runs of redfish in Cook Inlet, Copper River, and Chilkat, but the early runs in these localities are straggling fish, and were it not for the king salmon no attempt would be made to take the redfish at the earliest dates. It appears that the redfish run earlier to the westward than in southeast Alaska. At Attu it is said they run May 1. While the run probably commences to the westward, yet the great difference in time shown by the records is not, in my opinion, altogether real. There are undoubtedly straggling redfish very early in all localities in Alaska, and in a place like Karluk, with a catch of nearly 2,000,000 fish, these early stragglers must come in sufficient numbers to warrant commencing cannery operations, while at a stream having a production of 30,000 to 40,000 fish they may be represented by only a few individuals. Proximity to the sea is, no doubt, also favorable to early runs. The late runs may be accounted for by similar reasoning. It is said that the fish in the late runs are in excellent condition.

It is a question whether the fish that school around Karluk all belong to the Karluk River; that is, whether they would all go up that river to spawn. For some unknown reason large schools of fish come in from the sea and, finding conditions favorable, school around the vicinity of Karluk, and from there distribute themselves in schools along the islands, the rivers on the southern side of the peninsula, and go as far as Cook Inlet.

ILLEGAL FISHING.

Sharp competition has caused most of the streams in Alaska to be excessively fished; it is also more or less responsible for the great amount of illegal fishing carried on in the past and at present. When, however, it is considered that the canneries in Alaska have been striving each season to increase the packs over those of the year preceding, and have resorted to every means to obtain the highest pack, it will be seen that even a person willing and anxious to comply with the law and to fish in a manner not injurious to a stream would soon be forced to abandon his ground. It is only fair to state that most cannerymen are willing to comply with the law regulating the fisheries. But where a few individuals evade the law in every possible manner, using methods which will eventually injure the fishery, and persist from year to year with impunity, there is little or no incentive for others to observe the law.

It is claimed that for a number of years fishing in the river has been limited. Competition has not yet wholly ceased, and frequent seine hauls are made in the river and many salmon taken which would have reached the spawning-grounds in the

lakes had they not been disturbed. After a salmon has once run the gauntlet of seines outside the river it should be permitted to perform its chief object in life. Until the law is strictly enforced and fishing in streams can not be openly done with impunity, those who have shown an inclination to protect the salmon fishery will have little encouragement. It is true that the number of salmon taken out of Karluk River is small as compared to the catch on the outside grounds; but even a limited amount of river fishing is sufficient to produce results injurious to the fishery.

Karluk River, like all streams in Alaska where the operation is feasible, has in past years suffered by barricades and zapors. In late years it is said there have been no barricades in the stream. For some time previous to 1889 a fence or barricade had been placed across the mouth of the river near the upper end of the estuary above the seining-ground; but it was removed in that year, and there has since been no obstruction except in 1891, when for a short time a fence was put in to aid in taking salmon for the hatchery which had been built.

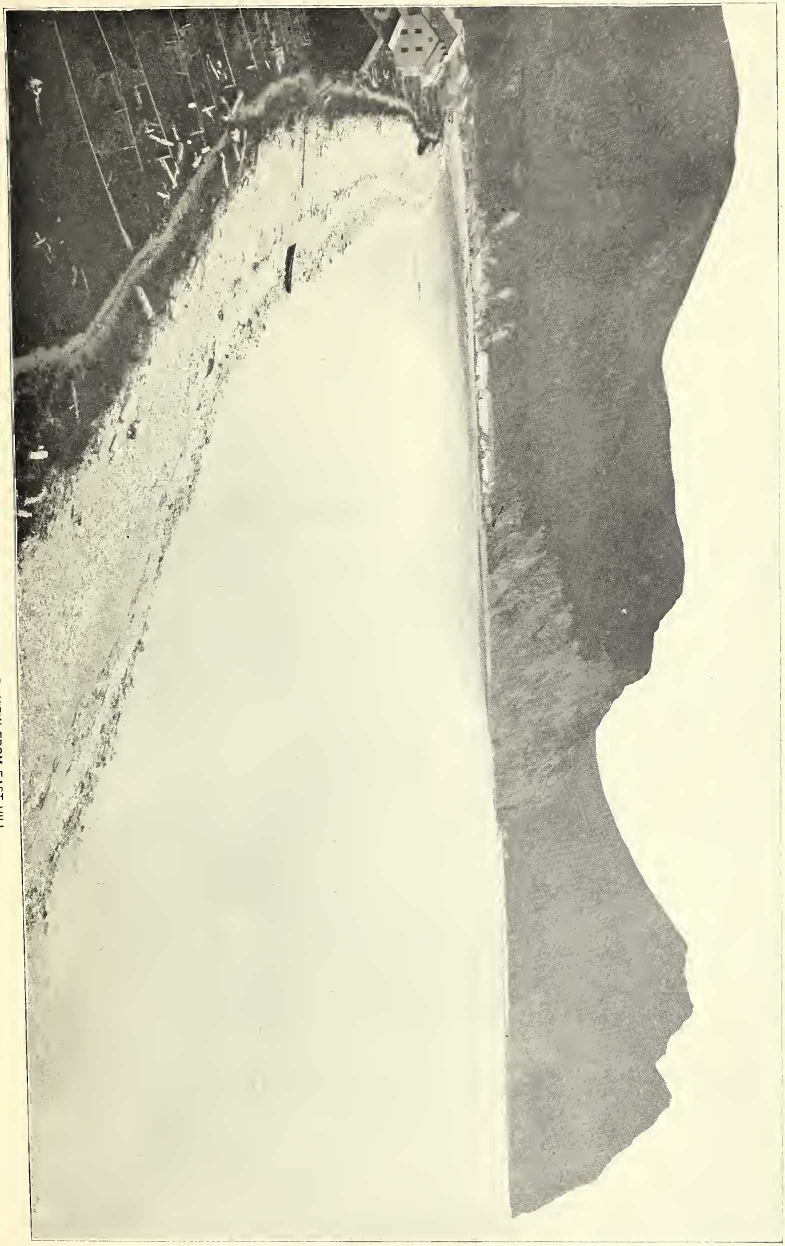
CANNERIES OF THE KARLUK DISTRICT.

That a prolific locality like the Karluk should be a bone of contention is only natural, and scarcely a year has passed that some struggle for supremacy between rival canneries has not disturbed the normal conditions. In 1896 the following canneries were open and made packs: Alaska Improvement Company under that company, and the Karluk Packing Company and the Hume-Aleutian under the Alaska Packers' Association. In 1897 the Alaska Packers' Association purchased the cannery of the Alaska Improvement Company and operated all the canneries. The transfer of property took place after the fishing arrangement had been made. By this purchase the association came into possession of all the canneries in the vicinity of Karluk, and purchased what they hoped was peace. But the spring of 1897 saw two canneries built at Uyak, about 18 miles from Karluk, expecting to make their pack from the Karluk beach. The contention arising from the fisheries of these canneries is now in the courts of San Francisco.

Karluk Packing Company.—In 1882 Messrs. Smith & Hirsch, who had been engaged in salting on Karluk Spit, built the first cannery on Kadiak Island. After operating it until 1884 it was organized under the title of the Karluk Packing Company, and has packed under that name every year to date. It joined the pool of the Alaska Packing Association in 1892, and became a member of the Alaska Packers' Association in 1893. It has a capacity of 2,600 cases per day. It has packed more fish than any other cannery in Alaska. Since 1882 the total is 844,642 cases, with an average of 52,790 cases per year. In 1888 it packed 101,304 cases. This cannery employed but few men at first—10 Chinese to perform the mechanical work, and two gangs of fishermen, 5 or 6 men in each, mostly natives. Two drag seines, each 40 fathoms long and 3 fathoms deep, were employed in capturing fish.

Kodiak Packing Company.—The cannery of this company was built in 1888 on the eastern end of the spit, and was operated in 1888, 1889, 1890, 1891, and 1893. It was a member of the pool of the Alaska Packing Association in 1892 and closed that year. In 1893 it joined the Alaska Packers' Association and was operated, but has been closed ever since that date and is held as a reserve. In 1891, under the agreement of the Karluk River Fisheries, this cannery packed the quota of fish allowed the Arctic Packing Company at Uyak Bay. It has a capacity of 1,800 cases a day.

PLATE 54.



OUTER SHORE, KARLUK SPIT, KADIAK ISLAND—VIEW FROM EAST HILL.

Hume Packing Company.—The cannery of this company was built in 1889 on the spit about 400 yards westward of Kodiak cannery, and has been operated every year to date. In 1892 it joined the pool formed by the Alaska Packing Association, and in 1893 it became a member of the Alaska Packers' Association. In 1891, under the agreement of the Karluk River Fisheries, the quota of fish allotted to the Aleutian Islands Fishing and Mining Company's cannery was packed in the Hume cannery, and after that date these two canneries were consolidated under the Hume, which is now known as the Hume-Aleutian. The capacity is 2,600 cases per day.

Aleutian Islands Fishing and Mining Company.—This company in 1888 built a cannery on Karluk Spit in a position which is now about 100 yards westward of the Hume cannery, and operated it in 1888, 1889, and 1890. In 1891 the quota of fish allowed under the Karluk River Fisheries agreement was packed in the Hume cannery, under an agreement known as the Hume-Aleutian compact. After 1891, however, the two canneries were consolidated and, as mentioned above are now known as the Hume-Aleutian. The building is used as a warehouse.

Alaska Improvement Company.—This company was incorporated under the laws of the State of California, and in 1888 built a cannery on the left bank of the outlet, opposite the point of the spit and facing the Shelikof Straits. It was ready to pack in 1888, but was not operated on account of the loss of the cannery ship, the *Julia Ford*. It made a first pack in 1889, and has continued each year to date. In 1891, under the Karluk River Fisheries agreement, the quota of the fish of the Russian-American cannery at Afognak was packed at the Alaska Improvement Company's cannery. It did not enter the pool of the Alaska Packing Association of 1892, nor the Alaska Packers' Association of 1893, but in the spring of 1897 it was sold to the latter organization, and is now operated by that company. It has a capacity of 1,600 cases a day. The cost of the cannery from the time of building until 1896, including all buildings, wharves, machinery, and improvements and additions, was $38,000.

Hume Canning and Trading Company.—In 1893 this company built a cannery on the beach under Karluk Head, about three-fourths of a mile northward of the Alaska Improvement Company, in what is known locally as Tanglefoot Bay. It was operated in 1893 and 1894, and in 1895 it was sold to the Alaska Packers' Association and operated by that organization; it was closed in 1896 and 1897. It is held as a reserve, and has a capacity of 1,600 cases a day.

OUTPUT AND EQUIPMENT OF THE KARLUK CANNERIES.

In 1896 the Alaska Improvement Company packed 87,613 cases of redfish, 12 to the case. No other fish were packed and none salted or smoked. Of the above, 15,580 cases were fish taken at Uganuk, which ran 10 to the case; 3,500 cases from Ayagulik; 340 cases from Kaguayak, and 10 cases from Little River. The balance, 68,183 cases, were from Karluk beach and lagoon. The Aleuts fished the lagoon and the white crews fished the beach fronting the property of the Alaska Improvement Company. Packing begun June 10, when 270 cases were packed—18 cases of Karluk fish and 252 cases from Uganuk. The last fish were packed September 15, all from Karluk. The nets were dragged as late as September 20.

During part of July and August the run of redfish was so large at Karluk that the company sold 101,000 to Hume Bros. & Hume and 54,000 to the Pacific Steam Whaling Company, both at Chignik, and only stopped selling fish to that point by agreement with the Alaska Packers' Association canneries, which were also shipping

fish to their cannery at Chignik, and upon request of the salmon inspector, who happened to be there and who saw the great loss of fish in transit and the poor condition in which they arrived at their destination.

In 1896 the Alaska Improvement Company employed 60 white and 18 Aleut fishermen, and 16 white and 122 Chinese cannery-hands, including boss, tester, and cook. The white fishermen were transported free from San Francisco to Karluk and return. From the time of landing until fishing commenced they were paid at the rate of $40 per month, and during this time were employed in getting boats, nets, gear, etc., ready for the season's work. From the time fishing stopped until their departure from Karluk the same rate was paid; during this time they were employed in clearing up and closing the cannery. The fishermen in 1896, at these rates, were paid 40 days in the spring and 54 days in the fall. While fishing they were paid $15 per 1,000 salmon, collectively, and a ration of 35 cents per day per man. Quarters, fuel, water, and salt were supplied and a cook and baker furnished, who together got $100 per month. The fishermen had no work on the vessel either way except to man the pumps. Full crews were kept on the vessels all the time.

The Chinese were transported each way free of charge, but they fed and bedded themselves. They contracted at 45 cents a case, and were found quarters, water, fuel, and salt. A cook was furnished who received $300 for the season. The boss Chinaman had an additional salary of $50 per month besides his lay, and the tester was hired independently and paid $350 for the season.

There were used 3 seines 500 fathoms long, 3¼-inch mesh stretched, 160 meshes deep at bunt, 100 meshes at the offshore end, and 60 meshes deep at the inshore end; 1 seine 350 fathoms long, 3¼-inch mesh; 1 river seine, 175 fathoms long; and 1 seine 150 fathoms long; value of all seines, $1.75 per fathom.

The large seines were used by the white crews on the outside beaches, and the small ones by the Aleuts in the river and lagoon. There were also 2 seines, 500 fathoms long, stretched and hung in the loft ready for use, and some spare web on hand, all valued at $2,000.

The Alaska Improvement Company used an experimental trap at Uganuk in 1896. As there is no timber in this country for piling and as the water is very deep, the trap was made floating. It had a leader of 200 fathoms with a pot 36 feet by 200 feet. Old seines, 3¼-inch mesh, were used in the leader. The following gear was used in anchoring and floating the trap: Six coils 2-inch, 24 coils 2½-inch, and 4 coils 3-inch rope; 400 keg floats and 10,000 cork floats; 12 400-pound anchors, 14 300-pound anchors, and 20 150-pound anchors. Depth of water at pot, 11 fathoms.

The Alaska Improvement Company placed a second floating trap at Uganuk in the spring of 1897, which was similar to the one just described, but larger. It had a leader of 300 fathoms, and a pot 50 by 300 feet, with a circular extension wing 100 fathoms long. Depth at pot at high water, 12 fathoms. There were used in the construction of this trap, aside from the web, 10 coils each of 1½ inch, 2-inch, 2½-inch, and 3-inch rope, 20 coils 2¾-inch rope, 10,000 cork floats, 900 three-gallon keg-floats, and many anchors. These traps were set at the time of the transfer of the property and turned over to the Alaska Packers' Association; but, as the fishery at Uganuk was a failure, they were taken up, and at the time of our visit they were stored in the cannery.

The Alaska Improvement Company employed the steamer *Kadiak*, of 58 tons, with a crew of 8, and valued at $23,000; the steamer *Alaska*, of 23 tons, with a crew

of 5, and valued at $7,500; the launch *Delphine*, of 5 tons, with a crew of 2, and valued at $4,500; the launch *Corinne*, of 5 tons, with a crew of 2, and valued at $3,750; the ship *Centennial*, of 1,139 tons, with a crew of 14, and valued at $14,250; the bark *Harvester*, of 716 tons, with a crew of 10, and valued at $7,750; the three-mast schooner *Premier*, of 292 tons, with a crew of 8, and valued at $9,000; also 7 beach seine boats 35 feet long; 2 river seine boats 25 feet long; 1 river seine boat 20 feet long—all valued at $4 per running foot. A large number of dories and skiffs were also used.

In 1896 the Karluk Packing Company and the Hume-Aleutian Packing Company were operated together and under one management, and the equipment will therefore be given under one head. The two companies employed in the fisheries and in the canneries 200 whites, 100 natives, and 200 Chinese. There were used 8 seines 450 fathoms long, 3-inch mesh, 145 meshes deep; 2 seines 425 fathoms long, 180 meshes deep; 1 seine 200 fathoms long, 100 meshes deep, all 3-inch mesh, valued at $1.50 per fathom. The vessels and boats employed were the steamer *Hattie Gage*, of 42 tons, with a crew of 8, and valued at $17,000; 2 launches of about 5 tons each, with crews of 2, and valued at $2,000 each; 13 lighters, valued at $400 each; 70 dories, valued at $25 each; 15 seine boats, valued at $125 each. The transports were the ship *St. Nicholas*, of 1,688 tons, chartered, with a crew of 19; the ship *Santa Clara*, of 1,473 tons, with a crew of 18, and valued at $30,000.

The Karluk cannery in 1896 packed 68,495 cases of redfish, averaging 12 per case, and the Hume-Aleutian 70,320 cases of redfish, of same average size. Both canneries packed from June 5 to September 18. No other fish were packed at these canneries.

In 1897 there were packed in the Karluk district 1,865,731 redfish, making 156,286 cases; also 1,500 cohoes, making 89 cases, or a total of 156,375 cases. Of this number, 2,113 cases were packed at Uganuk. The Alaska Improvement Company packed 49,852 cases of redfish from June 12 to September 21. The Karluk Packing Company packed 54,777 cases of redfish from June 3 to October 9. The Hume-Aleutian packed 49,633 cases of redfish from June 16 to September 20. The average number of fish per case was 11.94.

In 1897 the Karluk Packing Company, the Hume-Aleutian Packing Company, and the Alaska Improvement Company, operating together, employed 16 hatcherymen, 126 white fishermen, 49 whites around the canneries, 390 Chinese, and 25 natives, the latter as fishermen and around the canneries. Of this number, there were taken for the Uganuk cannery 20 white fishermen, 12 white cannery-hands, and 96 Chinese. As the fisheries at Uganuk were a failure in 1897, these hands were all transferred back to Karluk early in July, so that the number first stated may properly be credited to the three canneries operated in 1897 at Karluk.

For the Karluk fisheries there were used 3 drag seines each 500 fathoms long, 125 meshes deep; 8 drag seines each 450 fathoms long, 145 meshes deep; 3 drag seines each 425 fathoms long, 180 meshes deep; 3 drag seines each 200 fathoms long, 100 meshes deep—all 3-inch mesh, and valued at $1.75 per fathom.

The steamer *Kadiak*, of 58 tons, with a crew of 8, and valued at $20,250, was regularly employed, and the steamer *Hattie Gage* was under charter part of the time and used as a reserve part of the time. Four launches were also used, the *Aurora*, *Ida*, *Delphine*, and *Julia M.*, valued, respectively, at $3,700, $2,700, $2,500, and $2,000, all of about 5 tons and carrying 2 men each. The transports were the ship *Santa Clara*, of 1,473 tons, with a crew of 18, and valued at $30,000; the chartered ship *St. Nicholas*, of 1,688 tons, with a crew of 19; the bark *Nicholas Thayer*, of 556 tons, with

a crew of 11, and valued at $10,000; the bark *Merom*, of 1,159 tons, with a crew of 15, and valued at $16,000.

The *Santa Clara* made two trips to Karluk; the *Nicholas Thayer*, besides the Karluk trip, made two trips to Loring, and the bark *Merom* made one trip to Naknek. The canneries used 13 lighters, valued at $400 each; 21 seine boats, valued at $125 each; and 113 dories, valued at $25 each. There is a large amount of spare equipment on hand.

The Chinese contract was 40 cents a case, and, as is always the arrangement, on a guaranteed pack. The fishermen have wages until fishing begins, and then an allowance per case. This nets them about $45 per month and board.

REGULATION OF WORK IN CANNERIES.

The canneries at Karluk and the one at Uganuk are under the management of one general superintendent. Each cannery has its foreman and regular number of employees, and in many ways they are separate and work independently of each other. The fish caught are equally divided among the canneries, the pack of each from day to day being so regulated as to amount to about the same. Each cannery packs salmon under the original brands used previous to coming into the association. It has been found necessary to do this in order to hold the established trade. Had new brands been substituted, considerable confusion and dissatisfaction would have arisen, followed by a decrease in the demand for Karluk salmon, for after establishing a reputation a brand of salmon can not be changed without a loss to the cannery.

FISHERMEN IN THE KARLUK REGION.

Each fishing gang has a boss, who directs the setting of the seine and the handling of the boats. Seines are set in their regular turn; as soon as one haul has been made another is commenced. This is kept up day and night when fish are plentiful and the weather and tide favorable. On shore two men, who are known as shore-boss fishermen, keep a sharp lookout for any signs of salmon which may appear off the spit. If, in their judgment, the conditions are favorable for setting seines, the fishermen are called out and repeated hauls made. It frequently happens that fish will be jumping and no particular notice taken of them; at other times one or two salmon observed will be sufficient for the seine to be set. Long experience has taught these men when to make hauls to obtain the best results. They are governed largely by the weather, direction of the wind, and the way fish are playing.

SIZE AND NUMBER OF SEINES.

It has been frequently found necessary to increase the number and length of the seines at Karluk. Commencing with nets 40 fathoms long, they have now reached a length of 500 fathoms. The average length, however, is 450 fathoms. The size of mesh is 3 inches, stretch measure.

A large amount of web and other material for making seines is kept in stock. In the spring the necessary seines are manufactured; when one is worn out, it is replaced by another. The wear which seines receive in this fishery is considerable, and the number expended each year amounts to several thousand fathoms. The quantity of web, corks, and rope kept on hand for making seines varies but little from year to year. In 1895 an inventory of the amount on hand was taken, and, as there has been no material change since, the quantity for that year will answer for 1897. At the

SEINING AT KARLUK

A. P. A. CANNERY AT CHIGNIK BAY.

beginning of the season mentioned 11,520 fathoms of web were on hand, equal to about 26,000 pounds, representing in value nearly $4,000, at 15 cents a pound. A seine such as is used here, finished and ready to put in the water, costs 35 cents a pound, which is approximately equivalent to $1 a fathom. This includes corks, leads, head and foot lines. The total length of seines used in 1897 was 6,975 fathoms, representing a value of $6,975. It is difficult to ascertain the number of fathoms of web worn out during a season's fishing, but it is safe to say that the amount reaches nearly two-thirds as much as the combined length of seines hung at the beginning of a season. The small seines, 200 fathoms long, are used in the river; those 425 fathoms and 180 meshes deep are used mostly off the beach in Tanglefoot Bay. The water here is somewhat deeper than off the spit, and requires seines of different dimensions.

IMPROVEMENT IN THE METHOD OF SEINING.

Previous to 1896 seining at Karluk was performed by hand. In that year steam power was introduced, which greatly facilitated the work and reduced the manual labor fully one-half. Formerly the time occupied in setting and hauling a seine was from four to six hours, depending largely on the weather and other circumstances. The average time required to make a haul under favorable conditions was about four hours. In setting a seine the inner end was anchored close to the beach; the outer end, when thrown out of the boat, was usually the length of the seine rope from the shore, about 75 to 100 fathoms. The seine rope was then run to the shore and taken to a wooden capstan. Setting the seine was comparatively easy, but it required the united strength of the crew to haul it in, and frequently the assistance of a second crew was needed. In this way only a few hauls could be made each day. The labor connected with this kind of fishing was hard, and only men inured to exposure could continue through a season.

The easiest part of the work was in surrounding the fish. The crew consisted of 18 men, 8 to row the boat, 2 to tend the seine as it ran out over the stern, 6 on the beach, and 2 stationed in dories to keep the foot line and cork rope clear. Drag seines are not thrown from the boat in the same manner as purse seines; the latter are stowed in evenly piled layers, the corks aft and the twine forward, and set from the side of the boat. Drag seines are stowed with considerably less care, as they run out with little assistance while the boat is being rowed.

STEAM POWER IN THE KARLUK FISHERIES.

The introduction of steam power on shore and the use of steam launches in setting seines has done away with a large portion of the manual labor connected with the fishery. Stowing seines and handling the catch require the same labor as heretofore. In setting a seine assisted by a steam launch, the inner end of the seine is anchored or otherwise fastened near the beach, as was the former custom when all work was performed by hand. The seine boat starts from the shore, from 6 to 8 men at the oars, and 2 men stationed at the stern who keep the seine from fouling as it runs out. When about 75 or 100 fathoms of net have been let out, a steam launch takes the seine-boat in tow. The men take in their oars and give all their attention to the seine, which is rapidly running out. When the seine is set it forms a semi-circle, the outer end being from 600 to 800 feet off shore. The launch then commences to tow this end of the seine to the beach, making a wide sweep, so as to cover as much ground as possible. This frequently occupies an hour or more. When the end of the seine is

within about 200 feet of the shore the launch casts off the seine rope, which is picked up by the boat and taken to the shore and placed in snatch blocks which lead to a steam winch and are arranged along the beach. As the seine is hove in, the circle becomes smaller, and in order to have the rope at all times pull from the right direction the seine rope is shifted as the seine comes in, from the outer to the inner blocks. By this means the seine is landed on the beach at the desired spot. During this operation a man is stationed at the post from which the seine rope leads, and gives the necessary signals; he also shifts the seine rope from block to block when necessary.

After the end of the seine is landed on the beach, half of the seine has still to be drawn into a small compass in order to accommodate the size of the catch. This is done by hitching the hauling line around the body of the seine, fluting it as it comes home, and shifting the leads as may be required. In this way the entire seine is hauled in; the hauling is all done from one end. As soon as the seine is dragged into as narrow compass as desired, a dory is anchored a short distance outside the seine, the rode line is paid out until the dory reaches the cork rope, which is taken over the stern of the dory and made fast. This is called a "snag tender." A man is stationed on the outside of the corks to be ready to clear the foot line should it come in contact with anything on the bottom. When the wind is blowing on shore and any considerable surf is heaving in on the beach, the dory keeps the seine in position, preventing it from being thrown into a heap. The catch having been gathered into a bag formed by the net, the corks are made fast to the gunwale of two or more dories, as may be required, and the fish pitched into them with single-tined forks called "pews." When a large haul of salmon is taken, dip nets holding 18 to 20 fish or more are used; this is called "bailing out."

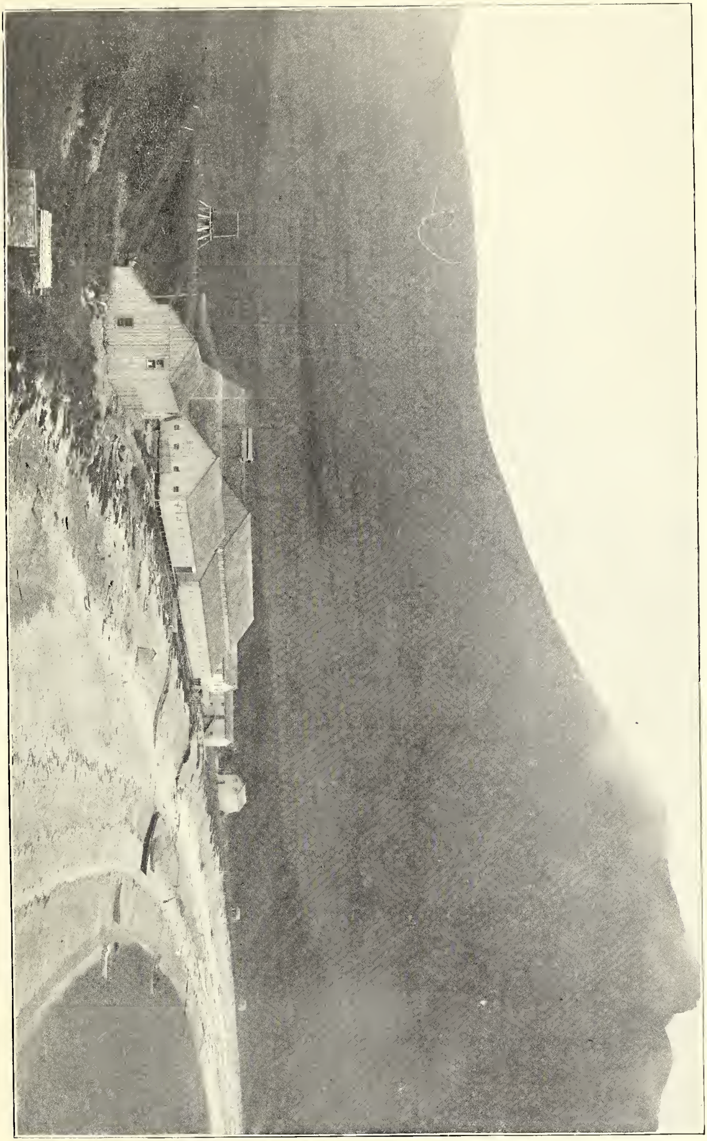
By the time one seine is half in, another is being set, and at no time when the weather is suitable and fish plentiful, except from Friday night to Sunday morning, is the fishing-ground free from seines. Frequently three and four are in the water at once.

It has been the custom not to set seines directly across the mouth of the outlet, but the manner of operation often makes it almost impossible for fish to ascend except in the early spring. Those that escape one haul are likely to be captured in the next. It is true that one day in each week no fishing is carried on. and during that time a considerable number of salmon pass in by the mouth of the outlet, but the majority of these are captured before ascending very far. If fishing in the outlet were entirely prohibited, it would aid very materially in keeping up the supply.

SHIPS AND BOATS.

A fishery so large as that carried on at Karluk requires many boats of different types. The expense of keeping these in repair and supplying new ones when needed is considerable. These cannery ships, like all others connected with the salmon fishery of Alaska, on leaving the home port in the spring are loaded with the raw material to be used during the season, which consists largely of box boards, tin, rope, and machinery; also the required amount of provisions. In most cases the superintendents, foremen, and bookkeepers of the canneries take passage in these vessels; the fishermen and Chinese help are also included among the number.

In all parts of Alaska where drag-seine fishing is carried on, the style of boats varies but little, they being about the same shape and build. Those used at Karluk are from 28 to 30 feet long and 9 feet wide, flat on the bottom, and square across the



UNUSED SALMON CANNERY AT TANGLEFOOT BAY, NEAR KARLUK

stern. The seine is stowed in the bottom of the boat, and when being set is thrown from the stern by two men. In localities where small seines are used a platform is built at the stern of the boats, upon which seines are stowed. Seines 450 fathoms long, such as are used at Karluk, can not be stowed to advantage on a platform, as considerable room is required, and in a short choppy sea, which is frequently encountered off the mouth of the river, the net would be likely to topple over.

The dories range in length from 16 to 22 feet. The large ones are used mostly in carrying salmon from the seining-ground to the canneries. When fish are plentiful and large hauls are made, scows are used. Small dories are used in tending the seines when set, such as clearing the foot line from bowlders or other obstacles on the bottom. The scows or lighters are principally for loading and unloading the ships, although they are frequently used in handling a large catch of salmon. There are several sizes, varying in length from 36 to 40 feet, the largest having a capacity of 800 cases.

SALMON HATCHERY NEAR KARLUK.

In 1891, when under the Karluk River Fisheries an apportionment of the fish was made for the year by mutual agreement, the organization built and operated a hatchery on the lagoon at a point half a mile below the present hatchery; 2,500,000 eggs were taken, but, owing to bad water, crude appliances, and want of experience, only about 500,000 fish were hatched. As the Karluk River Fisheries agreement went out of existence after the pack of 1891 and the canneries concerned could not agree in continuing the operations, the hatchery was abandoned.

The hatchery now operated at Karluk by the Alaska Packers' Association was built in 1896. It is situated on the southern bank of Karluk River about 2 miles from the outlet, and has been successful from the beginning. The first season, fall of 1896 to spring of 1897, 2,500,000 red salmon were hatched and liberated. In a recent letter from the superintendent of the hatchery, he states that he took over 5,500,000 eggs during the season of 1898, and that they were in an exceedingly healthy condition, the prospects being good for a large output with no undue losses.

Alaska, like most regions where hatcheries have been operated, presents a variety of conditions, both favorable and otherwise, under which artificial propagation must be carried on. A plan which has been followed with success in one locality may fail in another. It is extremely doubtful if there can be found in the Territory two places where propagation can be conducted in detail on precisely similar lines.

The building at Karluk is fitted with all the modern improvements usually found in a hatchery, such as steam engine, pump, and heating apparatus for warming the building and the water in the troughs and spawning pools. Approximately, the size of the hatchery building is 40 by 110 feet, and 1½ stories high. Half the upper floor is a general storeroom; the other part is divided into quarters for the employees; the kitchen and dining room are below.

At the time of our visit work was being actively carried on in the construction of spawning and rearing ponds, and buildings to cover them. One large pond had been previously built in the hatchery in which many of the small fry first hatched had been reared until liberated. It is also used to keep spawn fish in during cold weather. Another pond, situated near the bank of the river, had been used the first season for the same purpose. As the fish grow they are removed from the pond in the hatchery to the one outside.

The water supply is received from two creeks, one at the hatchery, the other three-fourths of a mile away. The water is admitted into the building through the roof, passes through several screens, and is distributed to the troughs under pressure from a tank. The supply reaches the troughs through a 6-inch pipe.

There are 13 sections of 4 troughs each, the total capacity of which is approximately 10,000,000 eggs. Taken as a whole the hatchery compares favorably with the best. Money has not been spared to make it first-class in every respect.

The water in the pond connected with the hatchery can be kept at any temperature desired. In this way a large number of fish can be held for a long period. The average temperature of water during the winter of 1896–97 was 32.5°. In the hatchery it was kept at from 38° to 43°. On a few occasions a temperature of 52° was reached. Many of the eggs were 155 days in hatching.

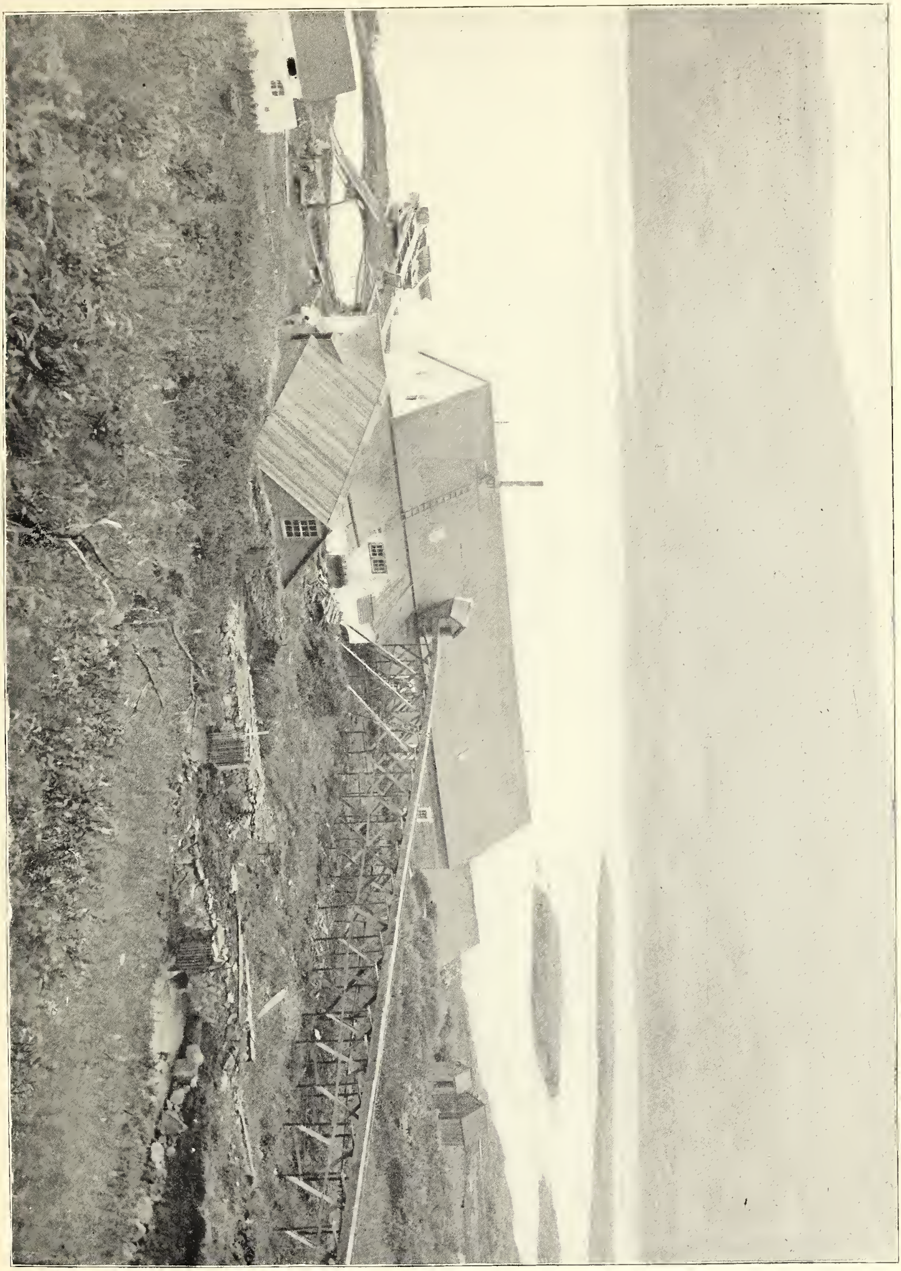
Few salmon were taken at the hatchery for spawning purposes from the 20th of July to the 5th of August. An abundance of fish entered the lower river, but as river fishing was being carried on, only an occasional salmon was observed as far upstream as the hatchery. Consequently the fishing gang, which was stationed on a projecting point making out from the southern bank of the river, watched for days for favorable signs, making repeated hauls with little or no success. The highest number of fish taken in one day was 83. This catch was made on the 5th of August, the day of our departure. The cause for this remarkable scarcity of salmon at the hatchery was attributable to the frequent seine hauls made inside the mouth of the river near the canneries, from 8,000 to 10,000 being taken there daily. Fish which escaped the seines off the spit were almost certain of capture before they could get very far up the river, thereby minimizing the chances of many being secured at the hatchery. The work of artificial propagation was thus greatly retarded, much to the discouragement of all concerned.

At the end of a fortnight it was deemed advisable to commence supplying the hatchery with spawn fish from the mouth of the river, as at that time the indications were that few salmon would be taken on the hatchery seining-ground. The first day 7,000 fish were caught and placed in the ponds. The mortality was considerable at first, but after a time better results were obtained. It was subsequently learned that during the latter part of August a number of good hauls of salmon were made off the hatchery. Most of the fish, however, were taken outside the mouth of the river.

As long as fishing is conducted in the river the hatchery will at most times labor under great disadvantage, for the seining-ground upstream can not then be depended upon to supply the number of spawn-fish required. Means should be taken to stop all commercial fishing, both in and directly off the mouth of the river. With all obstructions removed, there would during the fishing season be little, if any, difficulty in obtaining spawn-fish to run the hatchery at its fullest capacity, and at the same time this would not materially affect the pack of the canneries.

The spawn-salmon are transported to the hatchery by "cars." These are manufactured from discarded dories, and are said to be more serviceable and more easily handled than the ordinary square box car. The fish are placed in the cars as carefully as circumstances will permit. If the tide be low at the time the catch is made, the cars are tied up to the bank of the stream until the tide rises, for the river is too shallow to admit of their being towed to the hatchery, except after half flood-tide.

The transportation of stock salmon in the manner described was in its experimental stage, and the fish did not always arrive at the spawning ponds in good



REDFISH HATCHERY AT KARLUK.

condition. At this time the cars had no covering and the fish struggled wildly in their efforts to escape. This no doubt added largely to their death rate. It has since been learned that later in the season little difficulty was experienced in transferring and holding the fish. Another year, with the increased facilities contemplated, together with the experience gained concerning local conditions during the past two seasons' work, will bring this hatchery up to a high standard.

OFFAL IN KARLUK RIVER.

During a heavy run of fish a large amount of offal is daily thrown into the outlet. Three of the canneries are situated on the bank of the stream and one at the mouth. The refuse material coming from the one at the mouth is usually carried directly out to sea, but that which falls from the other three is for a long time swept back and forth, up and down the estuary, by the current of the stream and tide from the ocean. A considerable amount of this material is sometimes thickly strewn over the bottom, frequently in the path of salmon on their way upstream. At the time of the writer's visit to the river the daily catch of salmon was small, and a correspondingly slight amount of refuse matter was visible; but enough was noticed to form an opinion as to the quantity that would have been dumped into the river had the catch been large.

Inquiries were made of different individuals connected with the fishery as to whether offal in any way affected the progress of salmon in their journey upstream. It was stated that at no time had it been noticed that the movements of salmon had been arrested by offal, either stationary or moving over the bottom. It was claimed that frequently a large number of salmon would be seen in that part of the river where the refuse matter was most abundant, causing the water to be very much discolored, which, so far as could be observed, did not in any way disturb their movements. With most marketable sea fishes, even a small amount of blood or refuse matter has the effect of driving them from the ground, and it would seem that the same rule would apply to the salmon. In order, however, to arrive at a definite conclusion in regard to this matter, a careful study would have to be made of the stream under various conditions. As this river has for years been the dumping ground for such large quantities of refuse, it would seem that its injurious effects are indeed slight.

ALITAK BAY.

Alitak Bay is a deep indentation, with several arms, on the southwestern end of Kadiak Island, about 65 miles from Karluk. A map and a description of the locality are given in Dr. Bean's report, in the Fish Commission Bulletin for 1889, pages 182–184.

The Arctic Packing Company in 1889 built a cannery in the southwest bight of Olga Bay, which is a branch of Alitak Bay, and is connected with it by a long, narrow passage. It has been operated every year since its construction, and in 1892 it was in the pool formed by the Alaska Packing Association, and in 1893 it entered the Alaska Packers' Association. It has a capacity of 1,500 cases. In 1891, under an agreement with the Kodiak Packing Company, in the same locality, the cannery of the latter company was closed and its quota of fish packed in the Arctic cannery. This cannery is the only one now operated in the vicinity of what is locally called the "south end."

In 1897 the company employed 25 white fishermen, 7 white cannery-hands, 10 natives, and 57 Chinese. The apparatus consisted of two drag seines each 250 fathoms long by 120 meshes deep, and two drag seines each 200 fathoms long by 100

meshes deep, one drag seine 100 fathoms long by 80 meshes deep; all mesh 3-inch. The vessels in the service of the company were the steamer *Aleut*, of 19 tons, with a crew of 4, and valued at $10,000; the bark *Kate Davenport*, of 1,175 net tons, chartered and used as a transport; three lighters, valued at $250 each; 4 seine boats at $150 each; 4 scows at $100 each, and 10 dories at $20 each.

The equipment statistics for 1896 are the same as for 1897, except that the bark *Coryphene*, of 771 tons, was chartered for transportation.

The pack for 1896 was made from June 11 to August 28, and consisted of 23,155 cases of redfish, averaging 12 to the case. No other fish were packed. The pack for 1897 was made from June 9 to August 29, and consisted of 513,000 redfish, making 37,401 cases, or an average of 13.7 fish to the case. No other fish were packed, and none salted.

The Kodiak Packing Company in 1889 built a cannery in Snug Harbor, a cove in the passage connecting Olga Bay with Alitak Bay, and operated it in 1889 and 1890. In 1891 its quota of fish was packed in the cannery of the Arctic Packing Company. It entered the pool formed by the Alaska Packing Association in 1892, and in 1893 became a member of the Alaska Packers' Association. The same year the machinery was moved to Karluk, where some was utilized and some held in reserve. It is now dismantled.

UYAK BAY.

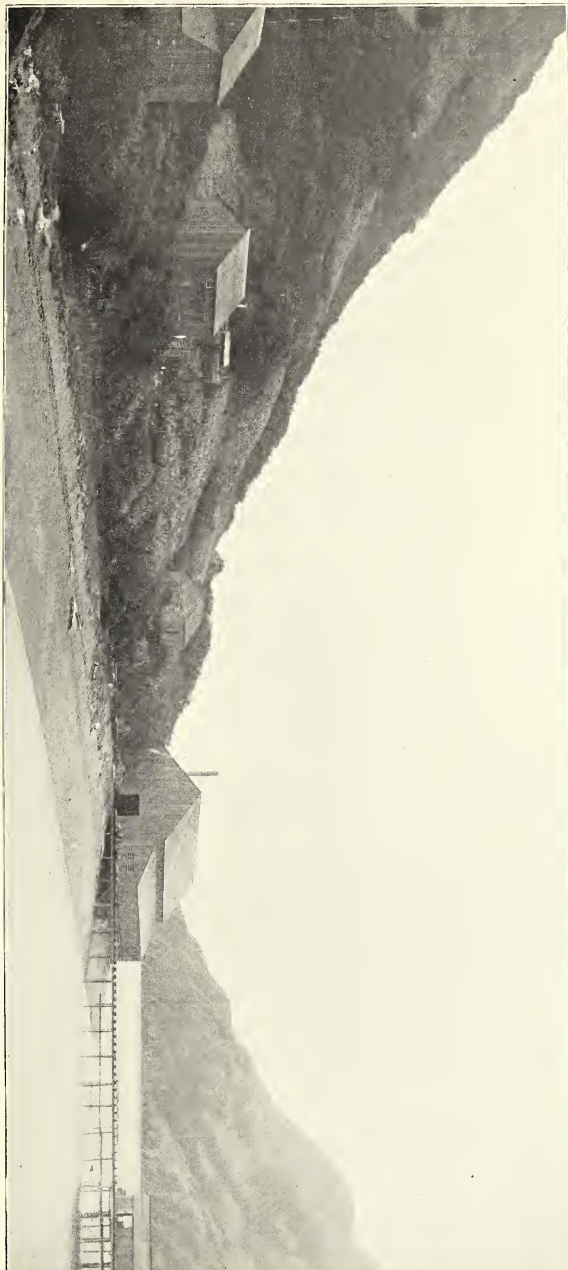
Uyak Bay makes into Kadiak Island on the northwestern side, about the middle of its length, and is an extensive sheet of water with ramifying arms, one reaching within a short distance of the southern coast of the island. On the western shore, near the entrance and about 18 miles from Karluk, is Uyak Anchorage. It is an excellent harbor, formed by the main shore of Kadiak Island and Bear and Harvester islands, and is frequently used as an anchorage by cannery ships and the steamers from Karluk during bad weather. Here, on the main shore, are located two canneries.

The cannery of the Pacific Steam Whaling Company is the southernmost of the two, and was built in the spring of 1897, making a pack the same year. It has a capacity of 800 cases a day.

In 1897 the company employed 40 white fishermen, and in the cannery were 20 whites and 60 Chinese. Six drag seines, from 100 to 300 fathoms long, all 3-inch mesh, and valued at about $1.50 per fathom, were used; also one purse seine, 300 fathoms long, valued at $1,000. The vessels employed were the steamer *Golden Gate*, of 50 tons, with a crew of 5, and valued at $20,000; the launch *Beaver*, of 5 tons, with a crew of 2, and valued at $4,000; 2 lighters worth $350 each; 5 seine boats worth $100 each, and 15 dories worth $25 each.

From July 3 to September 15 the company packed 17,000 cases of redfish, averaging 12 to the case. The fish were taken as follows: From Karluk, 90,000; Waterfalls and Slide, 65,000; Little River, 6,000; Uganuk, 1,000, and Alitak, 42,000. The total number of redfish used was about 204,000.

The cannery of Hume Brothers & Hume is the northern one at Uyak Anchorage, and was built in the spring of 1897, making a pack the same year. It has a capacity of 800 cases a day. In 1897 it employed 75 white fishermen, and 32 whites and 60 Chinese around the cannery. They used 3 gill nets, 200 fathoms long, 30 meshes deep, 6-inch mesh, valued at 65 cents per fathom; 6 drag seines, 200 to 300 fathoms long, 100 to 125 meshes deep at bunt, valued at $1.75 per fathom. Their vessels were the steamer *Equator* (changed from schooner of same name), 40 tons, crew of 7, valued at $10,000;



CANNERY AT UYAK BAY.

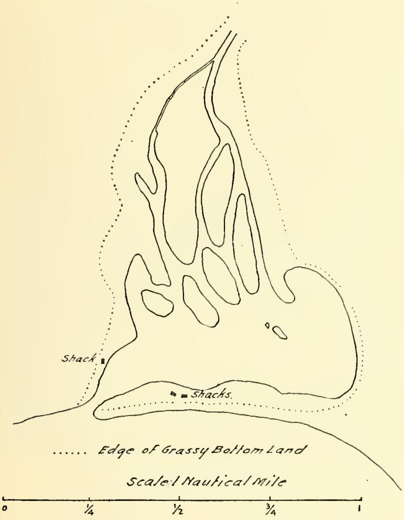
the bark *Harvester*, 716 tons, crew of 12, valued at $7,500; 2 lighters at $350 each; 12 seine boats at $100 each. The number of fishermen and cannery hands seems large for a small cannery, but it is the number given by the company. Some of the hands from their plant at Chignik may have been brought here and credited in error, to both canneries.

From June 14 to September 15 the firm packed 169,824 redfish, making 13,375 cases, an average of 12.7 fish to the case. Of this number 5,000 fish were taken in gill nets, and the rest in seines. They were taken at the Waterfalls and Slide, Uganuk, Little River, Red River, and Ayagulik, all on Kadiak Island.

A few small streams carrying salmon flow into Uyak Bay and its branches, but none is known to carry redfish.

LARSEN BAY.

Five miles southeast from Uyak Anchorage is a narrow arm called Larsen Bay. It is 4 miles long, with a general east-northeast and west-southwest direction. Immediately within the entrance, on the northern shore, is the site of the cannery of the Arctic Packing Company, which was built in 1888, and operated in 1888, 1889, and 1890, but which has been closed since the latter date. In 1891, under the Karluk River Fisheries, its quota of fish was packed in the cannery of the Kodiak Packing Company at Karluk. In 1892 it entered the pool of the Alaska Packing Association, and in 1893 it became a member of the Alaska Packers' Association. In 1896 the available machinery was removed and utilized in the construction of the cannery at Uganuk. All that remains of the cannery is a large building used as a warehouse, the wharf, and a few sheds. A watchman is retained to look after the buildings, as the site has not been abandoned. When the cannery was operated the fish were obtained from Karluk, Little River, Waterfalls, and Slide.



Sketch of Vicinity of Little River.

From the head of Larsen Bay it is not more than 5 or 6 miles to Karluk Lake, which a party of five attempted to reach and failed.

LITTLE RIVER.

Little River, one of the fishing stations just mentioned, empties into Shelikof Straits about a mile to the westward of Cape Ugat. Hume Bros. & Hume and the Pacific Steam Whaling Company canneries at Uyak fished here in 1897, and have fish-houses located on the beach. The formation of the mouth of the river is similar to that at Karluk, but on a smaller scale. There is a small lagoon formed by a shingle

and bowldery spit closing up a valley running south-southeast and north-northwest. The lagoon is three-fourths of a mile wide along the spit, with open water extending three-eighths of a mile from it. The stream flows into the lagoon through several channels, forming a number of grassy islands. Above this the stream flows with little current through bottom land having a few patches of alders, which, a mile from the beach, narrows to one-eighth of a mile. The bottom of the stream is fine sand and gravel, and the shores are grassy but without beaches. The top of the spit is about 8 feet above the lagoon, and at the eastern end is the outlet, 30 feet wide, and running in a rapid to the straits.

UGANUK BAY.

Uganuk Bay is the next to the eastward of Uyak. From the lower end of the western bay three arms make off, which we have called the northeast, east, and south arms, respectively. At the junction of the east arm with the bay, on a sand and

Cannery at Uganuk Bay.

shingle beach on the northern shore, the cannery of the Alaska Packers' Association is located, and at the head of the arm is the redfish stream from which it draws its supply of salmon. For several years a saltery was operated by Mr. Oliver Smith in a bight on the southern shore of the east arm, a mile within the entrance. This was sold to the Association in 1897, and is now closed.

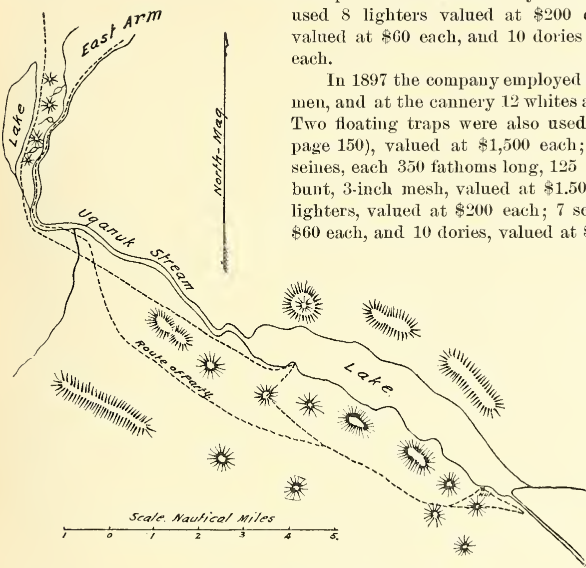
The Uganuk cannery of the Alaska Packers' Association was built during the spring of 1896, on the point forming the northern entrance to the east arm. The material used in its construction was largely from the cannery building of the Russian American Packing Company moved from Afognak, and the machinery is that which was available from the canneries of the Royal Packing Company at Afognak and the Arctic Packing Company at Larsen Bay (Uyak). The capacity of this cannery is

NATIVE VILLAGE ON UGANUK BAY.

1,400 cases a day. It made a pack in 1896, and commenced to pack in 1897, but was closed early in the season on account of a failure in the run of fish, and the employees were transferred to Karluk, where they assisted in making the pack. This cannery is in the Karluk district of the Alaska Packers' Association.

In 1896 it employed 20 white fishermen, 12 white cannery-hands, 16 natives, and 70 Chinese. It had one trap across the mouth of the river, valued at $800; 2 drag seines, each 350 fathoms long, 125 meshes deep, 3-inch mesh, valued at $1.50 per fathom. The station was attended by the Karluk steamer when necessary, and the transportation was done by Karluk vessels. It used 8 lighters valued at $200 each, 7 scows valued at $60 each, and 10 dories valued at $20 each.

In 1897 the company employed 20 white fishermen, and at the cannery 12 whites and 90 Chinese. Two floating traps were also used (described on page 150), valued at $1,500 each; also two drag seines, each 350 fathoms long, 125 meshes deep at bunt, 3-inch mesh, valued at $1.50 per fathom; 8 lighters, valued at $200 each; 7 scows, valued at $60 each, and 10 dories, valued at $20 each. The station was attended by the Karluk steamer, and the transportation was done by vessels from the same place. The company packed 21,005 cases of redfish in 1896, averaging 10 to the case, from June 10 to July 26. In 1897 they packed 2,113 cases of redfish, averaging 10 to the case, from June 10 to July 13. As there was a failure in the run, the cannery was closed and the force moved to Karluk.



Sketch of Uganuk Stream.

At the time of our visit, August 10 to 14, all gear was stored and the cannery was in charge of a watchman, so we saw none of the fishing. From the salmon inspector's report for 1895, from the accounts of different people connected with the fisheries here, and from personal inspection of the ground, the following information with reference to these fisheries was obtained:

In 1896 some of the force from the cannery of the Alaska Improvement Company, at Karluk, and the fishermen of the Uganuk cannery fished these waters. Besides using drag seines, the former company had a floating trap in the east arm, and the latter a net barricade almost entirely across the mouth of the river.

The river at its mouth flows over tidal flats in an east-and-west direction for a distance of 2 miles, having an average width of half a mile. These flats are largely uncovered at low water, having two channels through them, one close to the northern shore and skirting the native summer village; the other, entering near the center of the width of the arms, turns sharply to the northward around the northern end of a large rocky and wooded island, when it turns again to the westward. From the northern end of the island a line of piling was driven across the flats and the mouth of the river to the northern shore of the arm, leaving an opening in the low-water channel, across which a gill net was stretched.

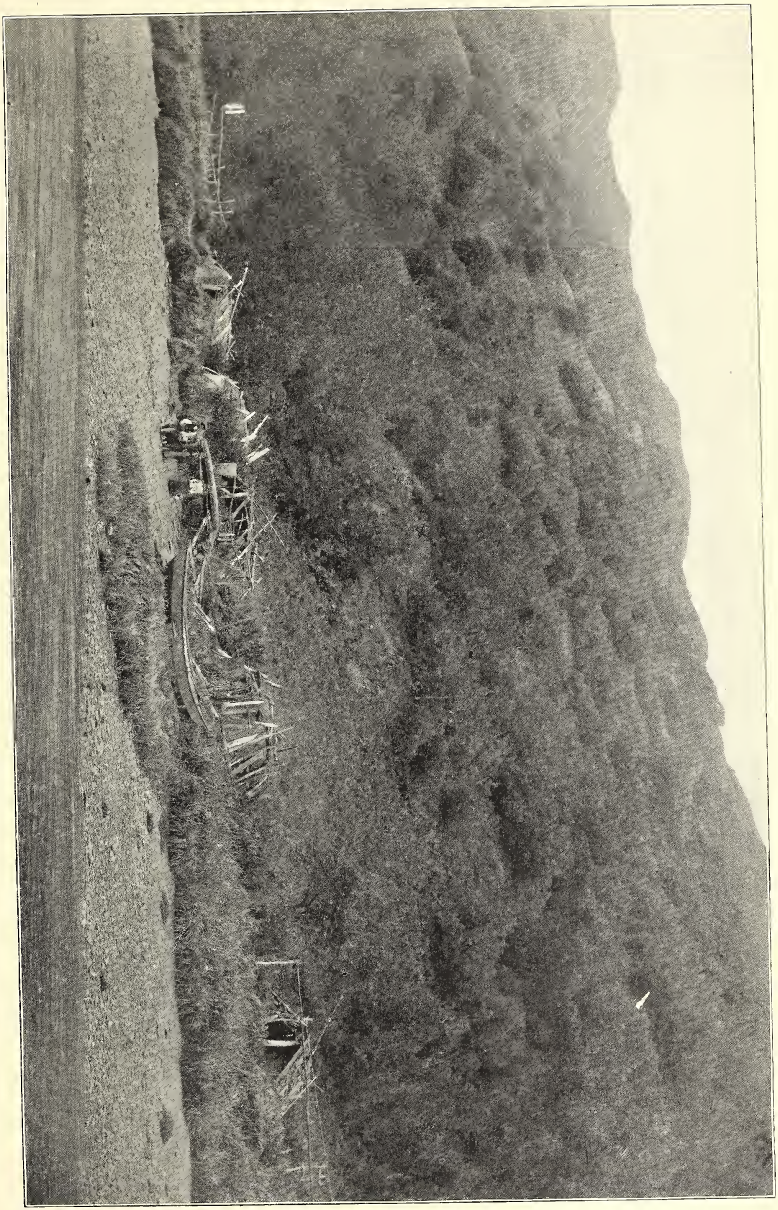
The trap described on page 150 was about a mile west from this barricade, leading from the northern shore, with the pot in deep water in the arm proper. Captain Phillips, of the Revenue-Cutter Service, directed this trap to be removed, upon which the Alaska Improvement Company protested to the Secretary of the Treasury, and the matter was referred to the Department of Justice. The correspondence, decision, etc., will be found on pages 8 to 10, salmon inspector's report for 1896.

In 1897 the Alaska Improvement Company replaced the 1896 trap and placed a second floating trap, leading from a point near the saltery on the southern shore. This must have been quite half a mile long, and at the point where it was set must have extended across the middle of the arm. The two traps undoubtedly commanded the arm. Upon the sale of the property the traps were turned over to the purchasers. Neither took many fish, and it is not unlikely that the larger trap was improperly set; that is, the pot was arranged for fish coming downstream. No traps had been used prior to 1896.

A party of five visited the lake at Uganuk. After a hard walk of five hours, covering a distance of about 12 miles, along sloping mountain sides, over grassy plains, through thickets of cottonwood, alder, and willow, and along bear trails, they reached a point on the lake about a mile within the outlet, but as the view of the lake to the southeast was cut off by intervening ridges, it was determined to reach the head of the lake. After crossing the mountains bordering the southern side of the lake, and obtaining a photograph of the river valley to the east arm, the party followed a valley of gradual ascent which carried them to a height of about 1,200 feet above the lake, whence the head of the lake and two inflowing streams could be seen. The head of the lake was reached after about five hours' walk from the first point.

The lake is somewhat crescent-shaped, about 6 miles long in a northwest and southeast direction, and of an average width of about a mile. It lies throughout its length between two ridge-like mountain masses which reach a height of 2,000 feet above its surface. The banks are steep, precipitous in many places, and heavily wooded to a height of 300 to 400 feet. There are numerous shelving beaches of gravel, black sand, and fine slate. The lake has the appearance of being very deep. At the southeast end are two inflowing streams about a quarter of a mile apart at the mouths; the larger one, flowing from the southeast, is about 40 yards wide, and the smaller one, flowing more from the eastward, is about 15 yards wide. From the top of the mountain the valley of the larger stream could be plainly seen for a distance of nearly 10 miles, the country, as far as could be seen, in this valley being heavily wooded with larger growth than nearer the coast.

The bottoms of both inflowing streams are large, with sandy and gravelly beds. A number of redfish of a red color were seen in the stream in places where the water



SUMMER FISHING VILLAGE ON STREAM AT HEAD OF UGANUK BAY.

flowed gently, and in depths of 2 to 3 feet. In the lake a large number of salmon indicated their presence by jumping. At a point about 500 yards within the mouth of the inflowing stream from the southeast, it is from 30 to 40 yards wide, with an average depth of 1½ feet and a velocity of 2 to 3 feet per second.

At the northwest end is the lake outlet, which flows generally with considerable velocity through a wide river valley. It is well wooded, having along its banks dense thickets of alder and willow interspersed with large cottonwoods. About 4 miles from its mouth a photograph was taken; here it is about 50 yards wide, 1½ feet deep, and flows with a velocity of 3 feet per second. Its general course is to the northwest, and from the lake to the mouth is a distance of about 8 miles. From the mouth the river flows into the east arm through a wide tidal basin at low water by two channels for a distance of 2 miles. About 3 miles above the mouth it receives a small tributary, which is also an outlet to a small lake.

In 1896 the canneries took 365,850 redfish from around the mouth of the stream. In 1897 the fisheries were a complete failure; the stream probably did not yield 15,000 redfish. The Aleuts say this failure was due to the lack of snow. The redfish from Uganuk are highly prized by the canneries, as they are much larger than the Karluk fish, running 10 to the case.

Inaccessibility renders this site unfit for a hatchery.

I may mention here the large number of bears infesting this region. Along the streams their trails cross and recross like the lines on a checkerboard. Half-consumed salmon were seen everywhere, and quite frequently salmon were noticed whose life was not yet extinct, having been abandoned by bears that had been alarmed at our approach.

AFOGNAK ISLAND.

Afognak Island was not visited, because there is no cannery in operation at that place now. While it seemed desirable to see the stream, it has been fully described in Dr. Bean's report, pp. 185–188 and pp. 207–208, Bulletin IX, 1889, United States Fish Commission. I will therefore only refer to it in connection with the brief histories of the canneries.

Afognak is a large island northeast of Kadiak, and separated from it and Raspberry Island by a narrow strait, which is much obstructed. On the southern side, near the western end, is Afognak Bay, which receives the waters of a lake outlet, and was once a very good redfish stream.

Mr. Livingston Stone examined this stream with especial reference to its adaptability for hatchery purposes, and in accordance with an act of Congress, approved March 3, 1891, the President, by proclamation of December 24, 1892, set aside "Afognak Bay, River, and Lake, with their tributary streams and sources thereof, and the lands including the same on said Afognak Island, and within one mile from the shores thereof, as a reserve for the purpose of establishing fish-culture stations, and for the use of the United States Commission of Fish and Fisheries, the boundary lines of which include the head springs of the tributaries above mentioned, and the lands the drainage of which is unto the same."

The stream at Afognak has been much abused by barricades. The Russians built a zapor in the river which has been maintained by their descendants, first for their own use, and afterwards to supply the cannery. Although the place is reserved by the Government, I am told that it is still fished (1897) for cannery purposes. The value of this stream some years ago was from 10,000 to 15,000 cases a year. Its present value is unknown.

The Royal Packing Company built a cannery in 1889 at the head of Afognak Bay, on the western side, three-fourths of a mile below the mouth of the river, and operated it in 1889 and 1890. Under the agreement of the Karluk River Fisheries in 1891, the quota of fish for this cannery was packed in the cannery of the Karluk Packing Company at Karluk. It entered the pool of the Alaska Packing Association in 1892, and became a member of the Alaska Packers' Association in 1893. It has not been operated since 1890, and it is claimed that the President's proclamation of December 24, 1892, reserving the stream at Afognak, has caused the cannery to be closed and dismantled. In the spring of 1896 the available machinery was moved to Uganuk, and in the building are now stored the boats and some gear of this cannery and of the Russian-American.

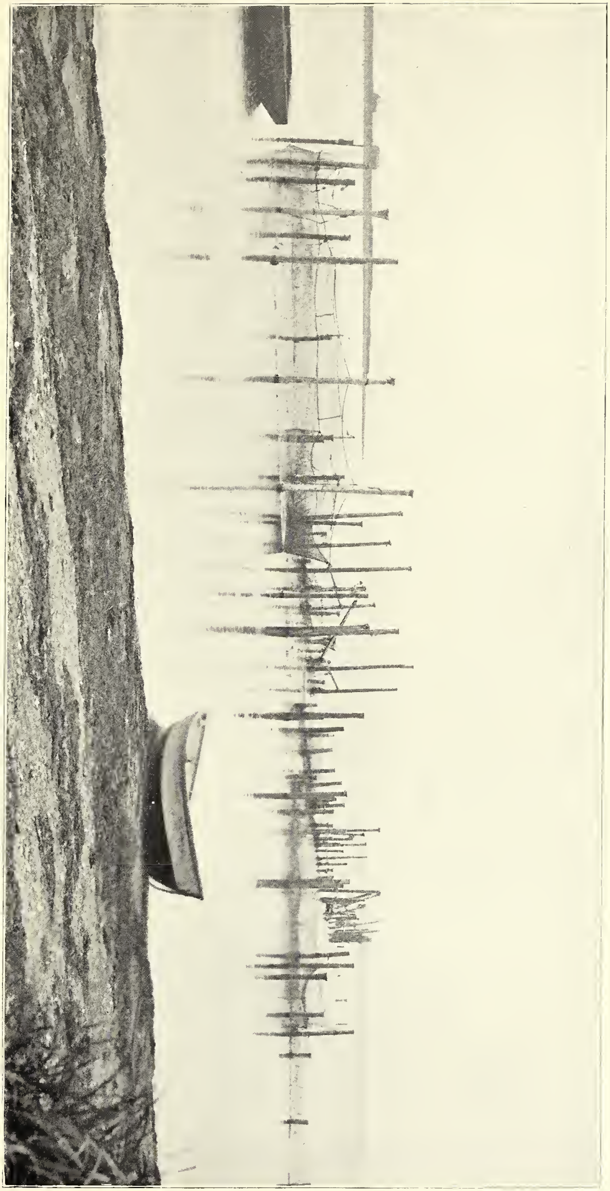
The Russian-American Packing Company was incorporated in December, 1888, and in 1889 built a cannery immediately above that of the Royal, which was operated in 1889 and 1890. In 1891, under the agreement of the Karluk River Fisheries, its quota of fish was packed in the cannery of the Alaska Improvement Company at Karluk. In 1892 it joined the pool of the Alaska Packing Association, and in 1893 it became a member of the Alaska Packers' Association. It has not been operated since 1890, and it is claimed that the President's proclamation of December 24, 1892, reserving the stream at Afognak, has caused the cannery to be closed and dismantled. In 1895 the available machinery was moved to the Ugashik (Sulima) River, in Bering Sea, on the western side of the Alaska Peninsula, and utilized as a part of the machinery in a cannery built at that point by the Alaska Packers' Association, and operated in 1896 and 1897. In the spring of 1896 the building was taken down and moved to Uganuk, and erected there for the cannery built that year by the Alaska Packers' Association. Nothing remains at Afognak of the Russian-American cannery except the boats, which are stored in the building of the Royal Packing Company.

There is a redfish stream on Afognak Island, known as Malinof River, which empties into Malinof Straits near its junction with Shelikof Straits. It has for years been heavily barricaded.

CHIGNIK BAY.

Chignik Bay, on the southern side of the Alaska Peninsula, is 150 miles west-southwest from Karluk, the position of one cannery in Anchorage Bay, an arm of the main bay, being in latitude 56° 17′ north, longitude 158° 23′ west. This is the next western locality after Karluk where canneries are now operated, and the westernmost outside of Bering Sea.

The southeast point of Chignik Bay terminates in a high-turreted or castellated point called Tulinmnit Point or Castle Cape, having on its western side a large arm making to the southward, called Castle Bay. Passing this bay and continuing along the southern shore to the westward, four headlands are seen forming the terminal points of high ridges, and between them are shallow bights and sand beaches. These beaches have the appearance of spits inclosing lagoons or ponds. To the westward of the fourth ridge, and about 12 miles from Tuliumnit Point, a small, deep bay, known as Anchorage Bay, makes in on the southern shore. This is partially protected by a sand-spit, affording good anchorage in deep water for all winds, except from the north. Two canneries are located here, and the transporting vessels of all the Chignik Bay canneries make their anchorage at this point.



POUND NET IN CHIGNIK BAY.

Continuing to the westward, another shallow bay makes in on the southern shore, known as Doris Bay, locally called Mud Bay, which has an indifferent anchorage off its mouth. Around the high, round, bold head next to the westward is the entrance to Chignik Lagoon, in the extreme southwest corner of Chignik Bay. Two canneries are located on this lagoon, and at the head is the mouth of the stream, from which all the canneries here and in Anchorage Bay draw their supplies of redfish.

In 1888 the Fishermen's Packing Company of Astoria, Oreg., sent a party to Chignik Bay to prospect for fish, and they returned in the fall of that year with 2,160 barrels of salt salmon.

The Chignik Bay Company's cannery was built and operated in the spring of 1889 by the Fishermen's Packing Company of Astoria on the eastern shore of Chignik Lagoon, $2\frac{1}{2}$ miles from the entrance. As this cannery is frequently referred to as the "Scandinavian," resulting in some confusion, it may be mentioned that prior to the building of this cannery the Fishermen's Packing Company purchased the property of the Scandinavian Packing Company of Astoria, and also built the cannery of the Alaska Packing Company on the Nushagak.

The Shumagin Packing Company, composed of capitalists from Portland, Oreg., built a cannery on Chignik Lagoon in 1889, near that of the Chignik Bay Company, and operated it that year, and the same year the Chignik Bay Packing Company, of San Francisco, built and operated a cannery near the two just mentioned. Though these three canneries were built by different companies, they soon became closely allied and finally combined into one organization, so that the history of one is practically that of all. The operating agreement of these three canneries was successfully carried out in 1890 and 1891. In 1892 they all joined the pool of the Alaska Packing Association, and the cannery of the Chignik Bay Company alone operated. In 1893 they became members of the Alaska Packers' Association.

Since 1891 only the Chignik Bay Company's cannery has been operated. The Shumagin building has been moved alongside that of the Chignik Bay Company and the machinery consolidated, so as to form practically one large cannery, with a capacity of 2,600 cases per day, which is operated, and erroneously called the Chignik Bay Packing Company. It is really the Chignik Bay Company, for the cannery of the former is in such condition that it can be operated independently on short notice, and is held as a reserve. It has a capacity of 1,500 cases a day.

In 1896 the Chignik Bay Company employed 73 white fishermen and 3 white coal-miners; in the cannery were 13 whites and 158 Chinese; 33 natives were kept at various employments. The company used 3 gill nets, 150 fathoms long, $6\frac{1}{4}$-inch mesh, valued at 65 cents per fathom; 9 traps, 1,350 feet long, at $1,000 each; 5 drag seines, 200 fathoms long, 3-inch mesh, 100 meshes deep at bunt, at $1.50 per fathom.

The vessels and boats were the steamer *Afognak*, of 38 tons, with a crew of 9, and valued at $15,750; the stern-wheel steamer *Baby Ruth*, of 10 tons, with a crew of 3, and valued at $4,500; 7 lighters, valued at $500 each; 10 trap scows, at $200 each; 2 pile-drivers, at $650 each; 12 seine and gill-net boats, at $125 each. The ship *Llewellyn J. Morse*, of 1,271 net tons, valued at $25,000, with a crew of fishermen, was used as a transport.

In 1897 the employees consisted of 57 white fishermen, 3 coal-miners, 13 white cannery-hands, and 103 Chinese. The fishermen used 3 gill nets, each 150 fathoms long, valued at 65 cents per fathom; 10 traps, averaging 1,350 feet long, valued at $1,000 each; 5 drag seines, each 200 fathoms long, 3-inch mesh, valued at $1.50 per

fathom. The vessels and boats were the steamer *Afognak*, of 38 tons, with a crew of 9, and valued at $15,750; the stern-wheel steamer *Baby Ruth*, of 10 tons, with a crew of 3, and valued at $4,500; the ship *Llewellyn J. Morse*, of 1,271 net tons, valued at $25,000, with a crew of fishermen; 8 lighters, valued at $350 each; 10 trap scows, at $200 each; 3 pile-drivers, at $650 each; 12 seine and gill-net boats, at $125 each.

The following shows the pack of the Chignik Bay Company for 1896 and 1897:

Year.	Species.	Number of cases packed.	Average number of fish per case.	Date of packing.
1896	Redfish from Chignik Bay	37,893	10	June 16 to Aug. 25.
	Redfish from Karluk	7,388	12	Do.
	Cohoes	2,204	11	Aug. 18 to Sept. 25.
	Humpbacks and dog salmon	* 876		Aug. 5 to Sept. 1.
1897	Redfish	36,834	12.4	June 8 to Aug. 27.
	Cohoes	942	11	Aug. 1 to Aug. 27.
	Humpbacks and dog salmon	383		July 31 to Aug. 25.

* There is no record of king salmon, though a few were probably packed and counted in with the cohoes.

Hume Bros. & Hume built a cannery on the eastern side of Anchorage Bay in the spring of 1896, and made a pack that year and in 1897. Its capacity is 800 cases per day. In 1896 they employed 40 white fishermen, 20 white cannery-hands, 90 Chinese, including boss, tester, and cook. Ten gill nets were used, each 200 fathoms long, $6\frac{1}{4}$-inch mesh, 40 meshes deep, valued at 75 cents per fathom; also 2 traps, 150 and 200 fathom leads, 40 feet square pots, web 3-inch mesh, valued at $1,200 each; 3 drag seines, 100 fathoms, 200 fathoms, and 250 fathoms in length, the larger ones 100 meshes deep at bunt, and all valued at $1.50 per fathom.

The vessels and boats were the steamer *Florence Hume*, of 8 tons, with a crew of 2, and valued at $3,000; the bark *Leon*, with a crew of 12, and valued at $7,000; the schooner *Equator*, of 69 tons, with a crew of 6, and valued at $6,000; 4 trap scows at $100 each; 1 sail scow at $500; 4 lighters at $350; 10 gill-net boats at $200 each; 8 skiffs, etc., at $25 each.

In 1897 the company employed 55 white fishermen, 10 white cannery-hands, and 65 Chinese, including boss, tester, and cook. The same equipment was used as in 1896, except 5 traps instead of 3, and instead of the bark *Leon* the bark *Ferris S. Thompson*, of 514 net tons, with a crew of 11, and valued at $7,500, was used as a transport.

The following shows the packs of Hume Bros. & Hume's cannery at Anchorage Bay for 1896 and 1897:

Year.	Species.	Number of cases packed.	Number of fish per case.	Date of packing.
1896	Redfish from Chignik Bay	9,343	10	June 16 to Aug. 25.
	Redfish from Karluk	8,300		Do.
	Cohoes	50	11	Throughout season.
	Humpbacks	200	20	July 20 to Aug. 20.
1897	Redfish	12,000	12	June 12 to Aug. 12.

In 1896 nearly all the Chignik Bay fish were taken in seines, and only 3,500 in traps. A few king salmon were salted for personal use.

In 1897 the fish were all taken at Chignik Lagoon or off the entrance, in the proportion of 4 in the gill nets, 2 in traps, and 1 in seines. No other fish were canned, smoked, or salted, and none were purchased.

The Pacific Steam Whaling Company in the spring of 1896 built a cannery on the eastern shore of Anchorage Bay, one-fourth of a mile south of the Hume cannery, and

made a pack that year and in 1897. Its capacity is 800 cases per day. In 1896 it employed 30 white fishermen, 15 white cannery-hands, and 58 Chinese. Its nets included 5 traps, 40 feet square pots, with leads of 150 to 200 fathoms, valued at $1,100 each; 2 drag seines, 250 fathoms long, 3-inch mesh, valued at $1.50 per fathom. The vessels and boats employed were the steamer *Salmo*, of 35 tons, with a crew of 4, and valued at $7,000; the bark *J. D. Peters*, which carried the outfit to the station in April and called in the fall for the pack; 11 lighters and scows, valued at $50 to $150 each; 1 pile-driver, valued at $650; 4 seine boats, valued at $60 each; and a number of dories, skiffs, etc.

In 1897 the company employed 60 white fishermen, 15 white cannery-hands, and 58 Chinese. The remainder of the outfit used is the same as for 1896, except that 8 traps, instead of 5, were in use, and 2 pile-drivers instead of 1.

The following shows the pack of the Anchorage Bay cannery of the Pacific Steam Whaling Company for 1896 and 1897:

Year.	Species.	Number of cases packed.	Number of fish per case.	Date of packing.	Remarks.
1896	Redfish from Chignik	14,000	10	June 18 to Aug. 25	Taken in traps.
	Redfish from Karluk	4,500	12	do	Do.
	Cohoes	90	11	July 18 to Aug. 15	Do.
	Humpbacks	2,800	20	July 20 to Aug. 20	Taken in seines.
	King salmon	125	3	Throughout season.	Do.
1897	Redfish	23,500	12	June 9 to Aug. 15	About 1,500 redfish from Karluk were not in condition for packing and were not used.
	Humpbacks	500	20	July 20 to Aug. 15	
	Cohoes and king				A few taken, but not separately accounted for.

The Chinese contract differs slightly according to locality, and more largely according to the manner of making the pack. The contract for one cannery was 40 cents per case for machine-filled cans and 45 cents for hand-filled. The Chinese boss was paid $50 a month in addition to his lay, and the tester $50 a month without lay. Passage to and from San Francisco was free, but they found their own food and bedding, only water and salt being furnished by the vessel. Quarters, fuel, water, and salt were furnished at the cannery. In all of the Alaska canneries the Chinese contract includes a guaranteed pack—that is, the cannery insures a pack of a certain number of cases; if it is not made, the Chinamen are paid the stipulated pack; if the pack overruns, they are paid extra at the same rates.

The contracts with the fishermen differ somewhat at each cannery, but they are usually made with the view of getting the largest number of fish and allowing the fishermen about $45 a month and board for 6 or 7 months. At one cannery in Chignik, in 1896, fishermen were paid $30 per month and one-fourth of a cent per case and board. They worked the vessel to and from the cannery. In 1897 the same cannery paid the Scandinavian fishermen the same rates as in 1896, but the Italians received $20 per month, $12.50 per 1,000 fish, and a per diem allowance of 35 cents per man for a ration. The boss fisherman had an extra $125 for the season. Nearly the same rates are made at all the canneries here.

Nearly all the fish packed in the canneries located on Chignik Bay are taken in Chignik Lagoon and the immediate vicinity. In 1896, on account of the very large run at Karluk, the canneries there could not handle all the fish taken on the spit—that is, they did not have outfit enough—and fish to the amount of about 20,000 cases

were sent to the Chignik canneries; but this was exceptional, and was stopped by order of the salmon inspector. Occasionally a cannery steamer will visit the streams between Tuliumnit Point and Kupreanof Point and secure a load of humpbacks.

CHIGNIK LAGOON.

Chignik Lagoon is in the extreme southwest corner of Chignik Bay and is joined to that bay by an outlet one-fourth of a mile wide, contracted at this point by a narrow sand-spit about 1¼ miles long, which makes directly across from the western shore. The main body of the lagoon is 6½ miles long, with a general southwest direction, and at the southwest end has a narrow extension, 1½ miles long, into which the river flows. Within the spit, at the entrance, it is 1¼ miles wide, opening out to 1½ miles at the Alaska Packers' Association canneries, and 1 mile beyond it attains a width of 2 miles. Four miles from the entrance is an island, 600 feet high, which contracts the lagoon on the side leading to the river to three-fourths of a mile. Southeast from this island are great mud-flats which are covered at high water. At a distance of 6½ miles from the entrance the lagoon contracts to one fourth of a mile, and a mile beyond it narrows to 100 yards. The upper trap is located here, and one-fourth of a mile beyond is the coal mine. In this locality the water is usually fresh, and the mouth of the river is practically in the vicinity of the upper trap.

The lagoon is shallow, the greater part uncovering at low water, exposing grassy flats, with a channel running along the eastern side as far as the cannery, where it breaks around a grassy middle ground, unites at the island, and continues to the river. One mile below the island the channel narrows to 100 yards, with a depth at low water of 4 feet. Above the island the flats are not so much exposed, but the channel is shoaler, 2½ to 3 feet being the best water through it at low tide. From the cannery the channel is buoyed. Bowlders brought down by the ice dot the flats here and there.

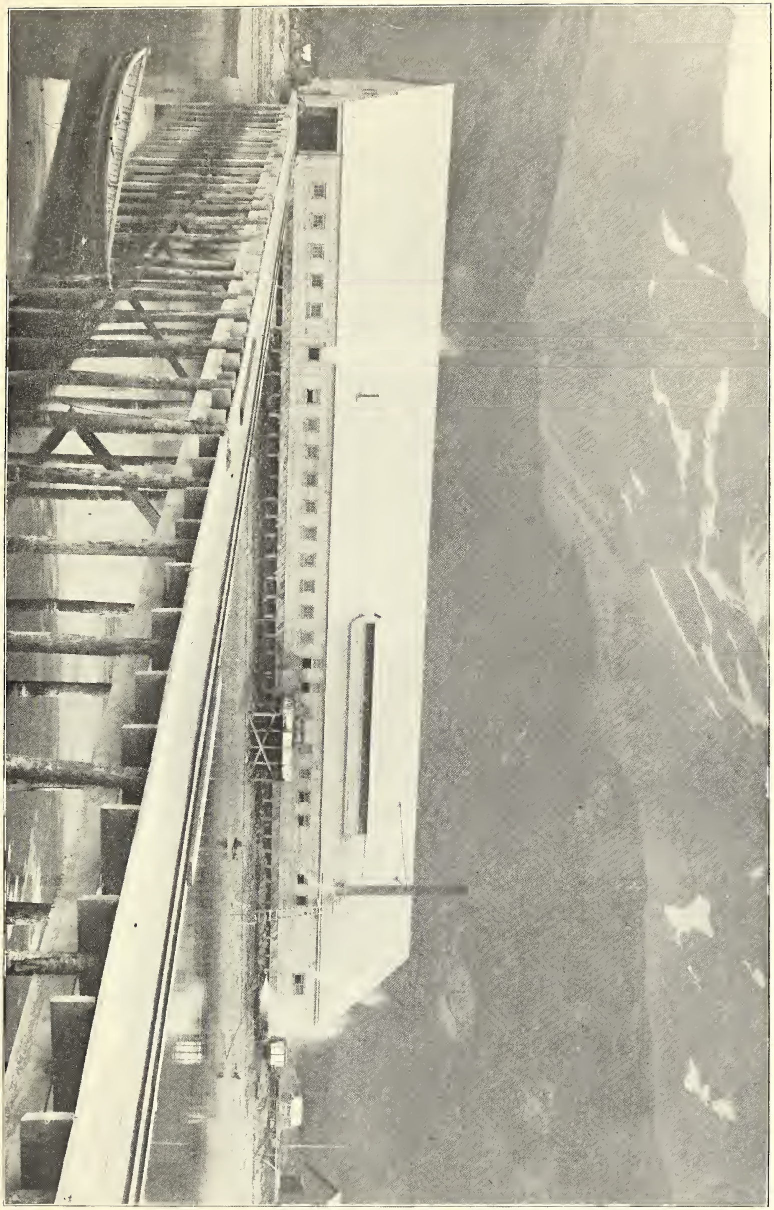
Outside the lagoon entrance the main channel is along the eastern shore, carrying about 3 fathoms at low water. There is also a narrow, shallow channel outside and along the spit, carrying 3 feet at low water, which separates the spit from a fan-shaped shoal, 1¼ miles long, which uncovers at low water and has a greatest width of three-fourths of a mile. At high water a small part of this shoal, near the spit, is just visible. Immediately within the entrance the water is deep and the banks are steep.

CHIGNIK RIVER.

Chignik River empties into the arm of the lagoon at its southwest end, and is estimated to be 6 miles in length, with an average width of 100 yards. The bottom is rocky and gravelly. High water, neap tides, extends to the coal mine, which is practically the mouth of the river, and high-water, spring tides, extends to the first lake, affecting the lake at the outlet a few inches. The depth in the river is such that a boat can ascend only at high water. At low water the current is very strong and forms many rapids.

There are two lakes. The first is about 10 miles long and of unknown depth. The banks in places are precipitous, in others sloping. In the latter localities the shore shelf is of sufficient width to permit gill netting, and then drops off suddenly. A number of small streams enter, but none except the second lake connection is of considerable size.

A shallow shifting arm, from 100 to 300 yards wide, leads through an extensive bog at the head of the lake, for a distance of 10 miles, to a second lake. The bog is



SALMON CANNERY OF PACIFIC STEAM WHALING COMPANY AT ANCHORAGE BAY.

black volcanic mud and probably the result of filling an old lake bed, which may have formed another lake connection in early times. The second lake is nearly of equal size with the first, but is shallow, with muddy bottom, the water here inclining to be muddy, while the water in the first lake is clear. A large part of the banks are low, but there are some bluffs on the northern side which continue some distance. A number of small streams enter the lake, and one of considerable size flows in from the northwest.

The redfish in immense numbers are said to spawn along the shore shelf of the first lake and in the mouths of the entering streams. A few redfish and more cohoes make their way into the second lake. Dog salmon and humpbacks spawn in these lakes, but they also enter the small streams that flow into the lagoon. Sculpins, perch, and other fresh-water fish occur. In the stream above the traps there are no obstructions. Formerly fishing was carried on over the spawning-beds, but this method is now abandoned. While all the species of Pacific salmon enter the lagoon and river, yet those other than redfish are so few in number that they are not considered in the pack. In relative abundance they stand as follows: Redfish, humpbacks, cohoes, dog, and king. No steelheads are taken here.

Chignik River is essentially a redfish stream, and the canneries may be said to pack only redfish. Occasionally a few humpbacks are packed, but they are obtained principally from streams between Tuliumnit Point and Kupreanof Point. The pack of king and cohoes never exceeds a few hundred cases from Chignik River. The few that are taken are generally used on the cannery table and the bellies salted for home use, while the backs may be packed under some different brand. Other fish are taken to a small extent.

The run of redfish commences the first days of June (a few were taken in 1897 for local use on May 15), and continues until the last of August. The run is usually considered large enough to pack from the middle of June to the middle of August. Cohoes run from the middle of July until after the cannery closes; the watchmen say until November. Humpbacks run from July 20 to September 1, and dog salmon about the same time, though both are found scattering throughout the season. The king salmon run in very small numbers, and are taken about the same time as the redfish.

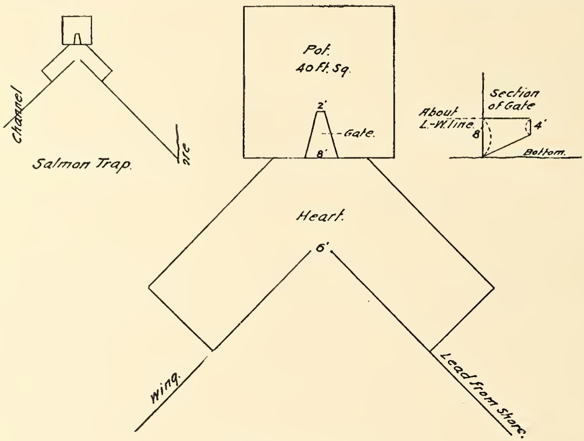
A very small salmon, weighing about 2 pounds, is recognized here as a different species, and called the Arctic salmon, but it is probably only a small redfish.

The weighing of 100 redfish from the bin gave the following results: Average 6.24 pounds, heaviest 10 pounds, lightest 4 pounds; average length 24 inches, largest 28 inches, smallest 21 inches. The red salmon in 1897 were said to run very small, 12 to the case; in 1896 they were larger, about 10 to the case.

One hundred cohoes were also weighed: Average 6.44 pounds, heaviest 10 pounds, lightest 2½ pounds; only one of each of these extremes, and a better range would be from 4½ to 9 pounds. Average length 23½ inches, greatest 28 inches, least 18 inches. The cohoes were running very small at the time of our visit, as it was the early part of the run, July 29.

The dog salmon run larger; that is, the average is higher, as there seemed to be few small ones. The humpbacks averaged about 3½ pounds in weight. The average weight of the king salmon at Chignik is unknown, but they were said to run very small for that species, though individuals weighing 60 pounds are reported to have been taken.

The fish are taken in traps, seines, and gill nets, and transported to the canneries on large lighters or fish-scows. It is said that the water is too clear for gill nets, and in 1897 they were not used by the Alaska Packers' Association or the Pacific Steam Whaling Company canneries, yet the Hume cannery seems to have been very successful with them. Traps are principally used here, and form the great bone of contention. At the time of our visit, July 29 to August 2, there were five traps outside the entrance to the lagoon, two just inside, and sixteen from the island to the head of the arm. They usually consist of a pot 30 to 40 feet square, with a heart and V-shaped leaders from 300 to 1,500 feet long, arranged with the apex up stream. The mesh of pots is 3-inch, and of leaders usually 4-inch. They are nowhere placed entirely across the main channel in the lagoon, but there are two or three which close up the shallow channel along the spit on the outside. In passing up the lagoon it seems almost



Chignik Lagoon Trap.

impossible for any fish to reach the river, for it looks as though a forest of traps obstructed the whole passage. With two exceptions, one end of the leader is connected with the high-water mark on shore.

The leaders or wings consist of nets hung on the upper side of rows of piles driven in a V shape, with a small opening in the upper end. This opening varies from 4 to 8 feet. The heart is formed by piles driven in an irregular box shape, inclosing the ends of the leaders. The nets are hung on the upstream side and, like those of the ends, are made fast at the top only, the bottom being weighted. They reach from above high water to the bottom. The pot is above the heart and is a square net bag, hauled out to piles at the corners, above and below, by ropes running through blocks. On its lower side is the gate, which is the entrance from the heart to the pot. It is a net stretched on framework, or having a frame at each end, the upper end being much smaller than the lower. It is 6 to 10 feet wide at its lower end, $1\frac{1}{2}$ to 2 feet wide at its

upper end, depending on the size of the trap. The top of the gate varies in its distance above low water, as does the bottom at the upper end below low water, depending on the depth of water at the pot. The trap fishes during ebb tide only, the loose bottom allowing it to clear itself of most of the grass during flood tide. The fish are taken out just after low water. The upper end of the gate is triced up, one side of the pot lowered, and a boat worked sideways into the pot, the lines holding the bottom corners being let go, and the net underrun until the fish are in a small space between the boat and the other side of the pot. They are then either scooped out with a scoop net having a handle balanced on the gunwale of the boat or are hooked out with a short hook on a handle about 2 feet long. If cod, flounders, etc., are numerous enough to interfere, they are hooked out; if not, the upper end of the net is let go and the flood tide clears the pot. Four men are required for each of the larger traps. Their principal work is to keep the traps as free as possible from grass and to repair breaks in the net caused by the weight collected, as well as to replace piles carried away in the deeper water by the strong tide. The traps are taken up after the fishing season is over, and changes are constantly made in their size and arrangement during the fishing season.

Seines are hauled on the flats southwest of the island, and on the western shore opposite, where a gill-net crew is also located. The shores are usually rocky or grassy flats. The outside beach on the spit is fine sand and gravel.

It is evident to anyone who examines Chignik Lagoon during the packing season that the place is overfished. For many years one organization fished here and made a pack averaging 61,400 cases, from 1890 to 1896. In the latter year two more canneries were built by rival companies, and all expect to make the pack from the product of one stream. The result is that all kinds of practices are resorted to, and the overtaxed stream must suffer by this excessive fishing. The traps are so close together and occupy so much of the channel that they look almost like barricades, but the stream is not entirely barricaded, probably because all would not be benefited alike. In some instances the tunnels or gates of the traps are lifted during the weekly close season, and in others they are not.

Locally it is said that the stream will stand a yearly pack of 100,000 to 150,000 cases. In my opinion 50,000 cases is all that can be taken here by fair legal fishing. In 1896, 87,769 cases were packed; in 1897, 74,159 cases. The 1896 pack, however, included about 20,000 cases of Karluk fish, and in both years a small pack of humpbacks from other localities was made. When the redfish cease to run in sufficient numbers for packing, about the middle of August, the Chignik canneries clean up and close for the season.

ORZENOY.

In 1889 a cannery, under the title of the Western Alaska Packing Company, was built at Orzenoy, on the western side of Stepovak Bay, south side of the Alaska Peninsula, and packed that year 6,400 cases. In 1890 a pack of 2,198 cases was made. As the locality proved unfavorable on account of the scarcity of fish, the cannery was dismantled in 1891 and the site abandoned.

THIN POINT.

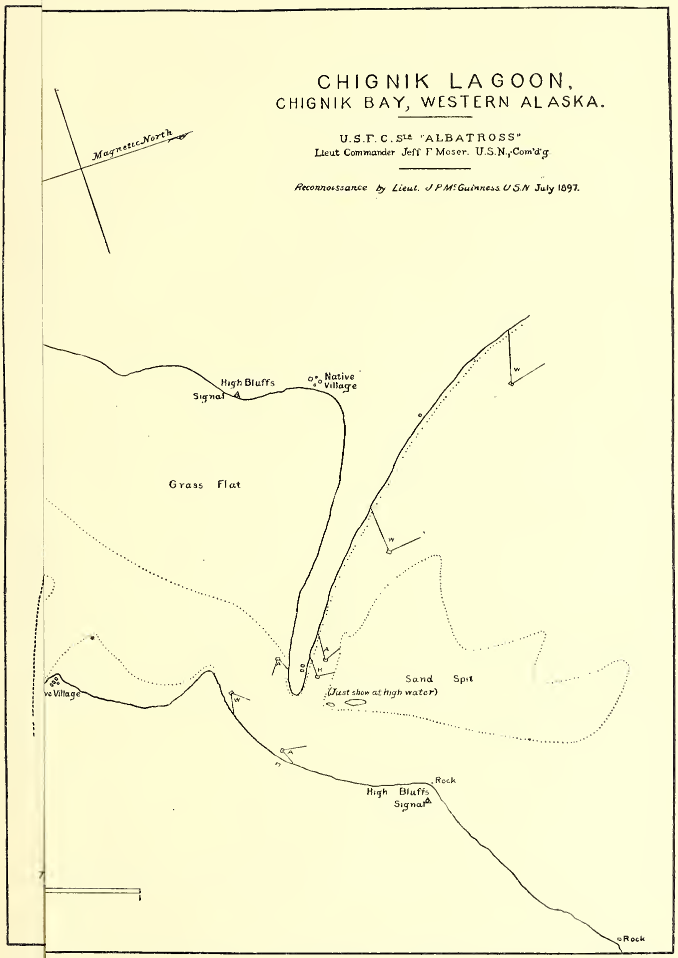
Thin Point is on the southern side of the Alaska Peninsula, near its extreme western end. Two canneries were formerly located here, but they have been removed and the site is practically abandoned. A saltery was operated at Thin Point for

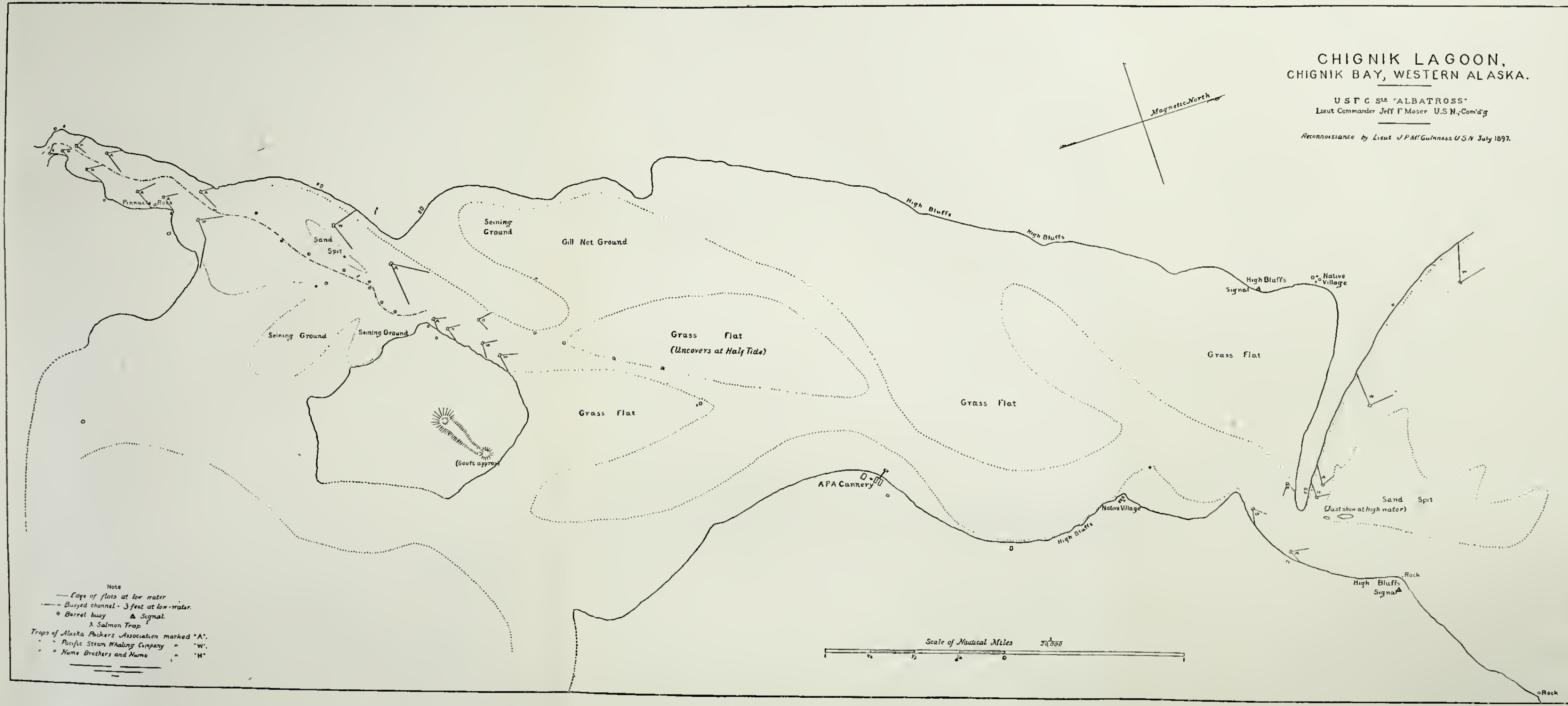
several years, until the Thin Point Packing Company was organized by Messrs. Louis Sloss & Co., of San Francisco, and the cannery was built in 1889. It was operated in 1889, 1890, and 1891, and was closed after that date. In 1890 the cannery ship *Oneida*, en route for Thin Point, was lost on the Sannaks in April; there were 77 Chinese on board and nearly all perished. A small pack of 2,401 cases was made that year. In 1892 it entered the pool of the Alaska Packing Association, and in 1893 became a member of the Alaska Packers' Association. In 1894 the cannery was moved to the Naknek River, Bering Sea, and utilized in the construction of the cannery of the Arctic Packing Company.

The Alaska Packers' Association operated a saltery at Thin Point in 1894, 1895, and 1896, but the place is now abandoned.

The cannery of the Central Alaska Company moved to Thin Point in 1890 from Little Kayak Island, and has already been referred to.

The main stream fished by these canneries is near at hand, on the eastern side of the point. There are two lakes near the sea, said to be well adapted for hatchery purposes. The stream is very uncertain; some years a large pack can be made from it, and then for a number of years the run is small. A person who had operated one of the canneries stated that the stream would yield at least 50,000 large redfish, and usually a larger number. As the place had been abandoned, it was not visited.


CHIGNIK LAGOON,
CHIGNIK BAY, WESTERN ALASKA.
U.S.F.C.Str "ALBATROSS"
Lieut Commander Jeff F Moser. U.S.N., Com'd'g.
Reconnoissance by Lieut. J P McGuinness U.S.N. July 1897.
Magnetic North
High Bluffs
Signal
Native Village
Grass Flat
Sand Spit
(Just show at high water)
ve Village
Rock
High Bluffs
Signal
Rock


CHIGNIK LAGOON,
CHIGNIK BAY, WESTERN ALASKA.
U S F C S^{tr} "ALBATROSS"
Lieut Commander Jeff F Moser U.S N., Com'd'g
Reconnoissance by Lieut J P McGuinness U S N July 1897.
Magnetic North
Seining Ground
Gill Net Ground
Sand Spit
Pinnacle Rock
Seining Ground
Seining Ground
Grass Flat
(Uncovers at Half Tide)
Grass Flat
Grass Flat
Grass Flat
(600ft approx)
High Bluffs
High Bluffs
High Bluffs
Signal
Native Village
APA Cannery
Native Village
High Bluffs
Sand Spit
(Just show at high water)
Rock
High Bluffs
Signal
Rock
Scale of Nautical Miles
Note
Edge of flats at low water
Buoyed channel - 3 feet at low-water.
Barrel buoy
Signal.
Salmon Trap
Traps of Alaska Packers Association marked "A".
" " Pacific Steam Whaling Company " "W".
" " Hume Brothers and Hume " "H"

BERING SEA DISTRICT.

The following brief histories and statistics of the Bering Sea canneries have been largely furnished by the Alaska Packers' Association, time not permitting a visit.

From the table of percentages of packs for the different districts, it will be seen that 35.2 per cent of the Alaska pack was made in Bering Sea in 1887. By the increase of canneries in other districts in 1888, and the still larger increase in 1889, the percentage of pack fell off and reached its lowest point (13.4 per cent) in 1892. From that date the percentage of pack has gradually increased until, in 1897, it reached 28 per cent of the whole Alaska pack, of which over nine-tenths was packed by the Alaska Packers' Association.

All the canneries in Bering Sea are located on the Nushagak, Kvichak, Naknek, and Ugashik rivers, all emptying into Bristol Bay (see Chart B).

NUSHAGAK RIVER.

On the Nushagak there are four canneries, as follows: Arctic Packing Company, Nushagak Packing Company, Bristol Bay Canning Company, and Alaska Packing Company. There is also a saltery operated by C. E. Whitney & Co., which in 1897 salted 2,436 barrels, principally redfish.

In 1883 the schooner *Neptune*, with a party, prospected for salmon on the Nushagak, and salted a large number. The same year cannery buildings were erected for the Arctic Packing Company, which was formed and commenced operations in 1884, making a pack of 400 cases that year. This was the first cannery operated in Bering Sea. It has made a pack every year to date, except in 1892, when it joined the pool of the Alaska Packing Association and was closed. In 1893 it became a member of the Alaska Packers' Association. The cannery is located at Kanulik, on the eastern shore, at the mouth of the river, and about 3 miles above Fort Alexander. It has a capacity of 2,000 cases a day.

The Alaska Packing Company built a cannery on the western shore of the Nushagak, near the mouth, in 1886, and made a pack that year, as it has done every year since. It entered the pool of the Alaska Packing Association in 1892, and the Alaska Packers' Association in 1893. It is located near the village of Kanakanak, and has a capacity of 2,000 cases a day.

The Bristol Bay Canning Company built a cannery immediately above that of the Alaska Packing Company in 1886, and operated that year and every year to date. It entered the pool of the Alaska Packing Association in 1892, and of the Alaska Packers' Association in 1893. It has a capacity of 2,000 cases per day.

The Nushagak Packing Company built a cannery on the eastern shore of the estuary at Nushagak in 1888, at a place called Stugarok, 11 miles below Fort Alexander. It was operated in 1888, 1889, 1890, and 1891; it was then closed and has not been operated since. It joined the pool of the Alaska Packing Association in 1892

and became a member of the Alaska Packers' Association in 1893. It is in such condition that it can be operated at short notice, and is held as a reserve. Its capacity is 1,500 cases per day.

These canneries are all owned and operated by the Alaska Packers' Association, and are under one local management. In 1897 they employed 144 white fishermen, 38 white cannery-hands, 306 Chinese, and 40 natives. Sixty gill nets were used, each 125 fathoms long by 24 meshes deep; 120 gill nets, each 75 fathoms long by 24 meshes deep; 4 traps with 300 feet leaders.

The following vessels were employed:

Rig.	Name.	Net tons.	Crew.	Value.
Steamer	Polar Bear	29	5	$12,000
Launch	Tyone	5	2	4,500
Do	Amy S	5	2	3,000
Do	Corinne	5	2	1,500
Ship	Sterling	1,637	Fishermen.	30,000
Do	Eclipse	1,535	(?)	Chartered.
Barkentine	Willie R. Hume	632	(?)	Do.
98 boats and lighters.				

The following gives the output of the three canneries for 1897:

Species.	Number of fish.	Number of cases.	Number of fish per case.	Barrels salted.
King salmon	18,139	5,823	3	32
Redfish	1,240,080	88,791	14	178
Cohoes	150,000	10,119	14.8	
Humpbacks	35,348	3,123	11.3	
Total		107,856		

Of the above, the Bristol Bay Canning Company packed 34,117 cases, the Alaska Packing Company 37,849 cases, and the Arctic Packing Company 35,890 cases.

The traps are used in Wood River, which empties into the estuary above the canneries on the western bank; the gill nets are used in the estuary where the water is muddy. No seines are used.

KVICHAK RIVER.

To the eastward of the Nushagak and emptying into the head of Bristol Bay is the Kvichak, with one cannery and one saltery.

The Prosper Fishing Company established a saltery at the mouth of the Kvichak in 1894 and operated it that year and the following. It was sold in 1896 to the Alaska Packers' Association and closed.

Under the name of Point Roberts Packing Company the Alaska Packers' Association established and operated a saltery at Koggiung on the Kvichak River in 1894, and built a cannery the following year, utilizing in its construction the available machinery from the cannery of the Central Alaska Company at Thin Point. It was first operated in 1896, and also packed in 1897. It is said to have a capacity of 2,000 cases per day. In 1897 the company employed 65 white fishermen, 10 white cannery-hands, 150 Chinese, and 25 natives. Twenty-five gill nets were used, each 60 fathoms long by 30 meshes deep, and 4 traps, with the inside leaders 300 feet long and outside leaders 250 feet long.

The following vessels were employed:

Rig.	Name.	Net tons.	Crew.	Value.
Steamer	President	238	8	$49,000
Launch	Northern Light	5	2	3,000
Do	J. W. Clark	5	2	2,000
Ship	Bohemia	1,529	Fishermen.	30,000
Bark	W. W. Case	556	Fishermen.	10,000
32 boats, lighters, and scows.				

The following is the pack for 1897:

Species.	Number of fish.	Number of cases packed.	Number of fish per case.	Barrels salted.
King salmon	345	126	2.7	220
Redfish	760,652	55,382	13.7	1,489

NAKNEK RIVER.

Naknek River empties into the upper part of Bristol Bay, about 20 miles below Koggiung. There are two canneries at its mouth.

The Arctic Packing Company built and operated a saltery at Naknek in 1890 and sold it to the Alaska Packers' Association in 1893. The association in 1894 built a cannery at the same place, utilizing the machinery of the Thin Point Packing Company in its construction. It was operated in 1895, 1896, and 1897, and has a capacity of 1,800 cases per day. Salmon are also salted here.

In 1897 the company employed 45 white fishermen, 10 white cannery-hands, 102 Chinese, and 10 natives. They used 11 gill nets, each 70 fathoms long by 24 meshes deep; 34 gill nets, each 70 fathoms long by 22 meshes deep; 3 traps with leads of 175 feet. The vessels employed were the launch *Ralph L.*, of 5 tons, with a crew of 2, and valued at $4,500; the bark *Merom*, of 1,159 net tons, with a crew of fishermen, valued at $16,000; the schooner *Prosper*, of 230 net tons, with a crew of fishermen, valued at $15,000; also 30 boats and lighters. The bark *Merom* made one trip on account of Karluk.

The following gives the pack for 1897:

Species.	Number of fish.	Number of cases packed.	Number of fish per case.
King salmon	902	180	5
Redfish	429,655	34,496	12.4

In 1890 Mr. L. A. Pederson established and operated a small saltery on the northern shore of the Naknek River near its mouth, and in 1894 the Naknek Packing Company was incorporated under the laws of the State of California, a cannery being built on the site of the saltery. The first pack was made in 1895, and operations were continued in 1896 and 1897. Salting is also carried on by this company. In 1897 an additional saltery was built on the shore of Bristol Bay about 2 miles above the mouth of the Naknek. The cannery has a capacity of 1,500 cases per day.

In 1897 the company employed 40 white fishermen and salters, 10 white cannerymen, 75 Chinese, and about 10 natives. The following was the equipment: 27 gill nets, each 100 fathoms long by 20 meshes deep, $6\frac{1}{4}$-inch mesh, valued at 40 cents

per fathom; 3 gill nets, each 100 fathoms long by 20 meshes deep, $8\frac{1}{2}$-inch mesh, valued at 40 cents per fathom; also 2 seines each 60 fathoms long, 100 meshes deep at bunt and 60 at ends, 3-inch mesh, worth $1.25 per fathom (used to empty trap); 1 double trap leading out 100 fathoms from beach in front of cannery, with two wings from the pot, 50 fathoms each in length, one up and the other down stream; width of pot, 20 feet; value, $600.

The vessels and boats were the launch *Emilia*, of 5 tons, with a crew of 2, and valued at $1,200; the bark *B. P. Cheney*, of 1,200 tons, with a crew of fishermen, and valued at $14,000; 1 lighter at $700; 6 lighters at $300 each; 1 pile-driver with engine valued at $300; 20 double-ended gill-net boats at $90 each.

In 1896 the company employed 36 white fishermen and salters, 6 white cannery-hands, 62 Chinese, and 10 natives. The remaining statistics are about the same as for 1897, except that the large lighter valued at $700 was new in 1897, and only 16 gill-net boats and 22 gill nets were used. The bark *Ferris S. Thompson*, of 514 tons, was chartered for transport.

The pack for 1897 consisted of 216,500 redfish, of which 215,000 were taken in gill nets and 1,500 in traps, making 18,000 cases, or 12 fish to the case. 16,000 of these fish were taken outside, the remainder in the river. Packing began June 30, and finished August 1. At the saltery 501 barrels of redfish were salted, 48 fish to the barrel, between July 1 and 14, and 99 barrels at the cannery.

In 1896 8,600 cases were packed ffom July 2 to August 2, all redfish, averaging 12 to the case. 175 barrels of redfish were salted to order.

The following redfish, running 48 to the barrel of 200 pounds, and all taken in the lower Naknek River, have been salted by this company since the station was opened: 225 barrels in 1890; 450 barrels in 1891; 1,100 barrels in 1892; 2,600 barrels in 1893; 2,630 barrels in 1894; 200 barrels in 1895.

EGEGAK FISHING STATION.

Egegak fishing station, also called Igagik and Ugaguk, is about 34 miles south of Naknek. In 1895 the Alaska Packers' Association established and operated a saltery at the mouth of the river, and have salted there each year since. In 1897 the company employed 10 white fishermen, 16 white saltery-hands, and 6 natives. Five gill nets were used, each 75 fathoms long by 26 meshes deep, and 2 traps with leads of 800 feet. The vessels and boats were the launch *Minnie*, of 5 tons, with a crew of 2, and valued at $1,600, and 9 boats and lighters. The three-mast schooner *Premier*, of 292 tons, with a crew of fishermen, and valued at $15,000, was used as a transport.

In 1897 this company salted 257 king salmon, making 15 barrels, and 203,458 redfish, making 3,574 barrels.

UGASHIK RIVER.

The Ugashik, or Sulima River, as it is sometimes called, is 70 miles south of Naknek, and is the most southerly station on Bristol Bay. There are two salteries and two canneries on this river.

The Bering Sea Packing Company, a branch of the Alaska Improvement Company, but a separate corporation, built a cannery at Ugashik in 1891, and operated it that year. It was closed in 1892 and in 1893, and operated in 1894, 1895, and 1896. It was neither in the pool of the Alaska Packing Association of 1892, nor did it join the Alaska Packers' Association in 1893. It was purchased by the latter organization

in the spring of 1897 and closed. It has a capacity of 1,200 cases per day, and at present is held as a reserve.

A saltery was established and operated at Ugashik in 1893 by the Alaska Packers' Association, and continued as such in 1894 and 1895. In the latter year the association built a cannery, utilizing in its construction the available machinery from the cannery of the Russian-American Packing Company at Afognak. It was operated in 1896 and 1897, and has a capacity of 1,800 cases per day.

At the Ugashik fishing station in 1897, 59 white fishermen, 9 white cannery-hands, 102 Chinese, and 24 natives were employed. Twenty-one gill nets were used, each 75 fathoms long by 24 meshes deep; also, one trap 150 feet inside leader, 80 feet outside leader, and 1 trap 250 feet inside leader, 80 feet outside leader.

The vessels and boats were the steamer *Thistle*, of 55 tons, with a crew of 6, and valued at $25,000; the launch *Cathie K*, of 5 tons, with a crew of 2, and valued at $2,500; the bark *Coryphene*, of 771 tons, chartered; also 53 boats and lighters.

The pack in 1897 consisted of 259 king salmon, making 11 cases (nearly all consumed fresh); 463,698 redfish, making 38,261 cases, or 12 to the case. 138 barrels were salted.

Mr. C. A. Johnson established a saltery at Ugashik in 1889, and has salted every year to date. The names of Norton, Teller & Co., and Metson & Co. frequently appear in connection with this saltery in the lists. They are simply the saltery agents.

Mr. Charles Nelson established a saltery at Ugashik in 1893, and operated it that year and in 1894. In 1895 it was sold to the Alaska Packers' Association and closed.

TOGIAK AND PORT MOLLER.

Togiak is on Togiak Bay, to the westward of Bristol Bay, between Cape Constantine and Cape Newenham. In 1895 the Alaska Packers' Association established a saltery here, which was operated in 1895 and 1896, and then abandoned.

At Port Moller, on the northern side of the peninsula, in longitude 160° 40′ W., Captain Herendeen salted salmon in 1886 or 1887.

WAGES IN BERING SEA DISTRICT.

The Chinese and fishermen's contracts for Bering Sea are similar to those referred to in other localities. The following for one cannery will give a fair idea of their value:

The Chinese receive free transportation and furnished quarters (without bedding), fuel, water, and salt. They are paid 42 cents per case. The boss receives $50 per month in addition to his lay, and the tester receives the same.

The fishermen receive $25 for working the vessel to the cannery and a like amount for taking her back. Two men form a gill-net crew, and the boat is paid 2 cents per fish. They are furnished everything except clothing, from the time they go on board the vessel until discharged.

Saltery gangs are paid at the rate of $30 per month and 15 cents a barrel (of 200 pounds) for the gang collectively.

The beach gang receives $40 per month per man, and, if detailed for fishing, in addition to this pay, receives ½ cent per fish. A cook and boy are provided to run the mess.

The natives are paid in various ways, but average from $1, the lowest, to $1.50 per day.

The Bering Sea season is short, and the pack must be made in from three to five weeks. The cans are usually carried to the canneries made up, and when the fish are running, work is continued day and night. The operations are carried on with no little danger. The tide rushes in and out of the head of Bristol Bay with great velocity, and in the estuaries bores are formed, which have caused the loss of a number of lives. After the pack is completed much difficulty is frequently experienced in loading it on the transporting vessel, on account of the strong currents and bad weather.

The *Albatross* visited the Nushagak in 1890, and spent some time there. The four canneries were in operation that year, and the Fish Commission report for 1889–1891 gives considerable information as to the fisheries of the region, on pages 284–287.

LIST OF FISHES KNOWN TO INHABIT THE WATERS OF THE DISTRICT OF COLUMBIA AND VICINITY.

By HUGH M. SMITH and BARTON A. BEAN.

INTRODUCTORY.

There is herewith presented the first published list of the fishes of the District of Columbia and vicinity. Much has been written concerning the fishes of the region, but the literature is scattered through many journals, newspapers, and Government reports, and pertains chiefly to the well-known game and food fishes, while the smaller fishes—important as affording food for the others—have been very generally neglected.

For convenience, the limits of the District may be regarded as extending over a radius of 20 miles from the Capitol, it having been the practice to include this area in former treatises on the fauna and flora of the region under discussion. The waters considered, therefore, are:

(1) The Potomac River, from Occoquan River, Virginia, to a point 5 miles above the Great Falls. Its principal tributaries in this section, beginning at the southern limit, are as follows:

In Maryland and District of Columbia: Mattawoman Creek, Accokeek Creek, Piscataway Run, Swan Creek, Broad Creek, Oxen Run, Eastern Branch or Anacostia River (with its tributaries, Sligo Branch, Northwest Branch, Paint Branch, Little Paint Branch, and Beaver Dam), Rock Creek and Piney Branch, Foundry Run, and Cabin John Run.

In Virginia: Pohick Creek, Accotink Creek, Dogue Creek, Little Hunting Creek, Hunting Creek, Cameron Run (and its tributaries, Back Lick Run and Holmes Run), Four-Mile Run, Roach's Run, Gravelly Run, Little River, Pimmitt Run, and Difficult Run.

(2) The Chesapeake and Ohio Canal and the Government reservoirs above Georgetown.

(3) The Patuxent River, Maryland, from Nottingham post-office northward, with numerous tributaries flowing from the west, the principal branches being the Western, Collington, and Mattaponi.

The fishes of this region have perhaps received less attention from local students than any other class of vertebrate animals. They are certainly not the least interesting and important group for study, and at the present time afford an excellent subject for investigation. Systematic collecting will doubtless add considerably to the list of species, and aid in the elucidation of questions pertaining to geographical distribution and variation.

The District fish fauna, as at present known, comprises 81 species, belonging to 62 genera and 31 families. The most numerous family, the *Cyprinidæ*, which includes the minnows and carp-like fishes, has 19 species. Other families with 5 or more species are the *Siluridæ* (catfishes), *Catostomidæ* (suckers), *Clupeidæ* (shad and herring), and *Centrarchidæ* (bass and sunfish). The local fish fauna has been considerably

enriched by the introduction of non-indigenous species, some of which are now among the best food and game fishes of the region. The acclimatized species, numbering about 10, are mostly members of the bass family and are indicated in the list. About 30 species are of economic importance, of which the principal are the shad, hickory shad, alewives, striped bass (better known locally as rock or rockfish), white perch, black basses, yellow perch, eel, sturgeon, suckers, carp, and catfishes. Some years ago the value of the fishes caught for market in that part of the Potomac under District jurisdiction was about $12,000, about half of which sum was credited to the shad. A recent act of Congress has prohibited all forms of net fishing in the District waters, which thus become an important nursery where such valuable species as the shad, the herring, the striped bass, and the black basses may spawn unmolested.

Four species recognized as distinct by recent authorities have been described from District waters; two of these are minnows (*Notropis*), one is a silverside (*Menidia*), and one is a darter (*Boleosoma*). From the Potomac have also come the types of a number of other species which are now regarded as identical with previously described forms.

An interesting feature of the fish fauna is the regular or occasional appearance in our waters of typical salt-water fishes. These are usually observed during dry weather, when there is an extension upstream of the zone of brackish water, which is normally about 40 miles below Washington; but a few, such as the silver gar, make deliberate visits to the fresh waters. The salt-water fishes which have thus far been detected within our limits number about 12; others may be looked for in spring and summer between Alexandria and Mount Vernon.

The following list includes all species of fishes known to occur in the vicinity of Washington, and is largely based on collections of the United States Fish Commission and United States National Museum. Those species of which specimens are preserved are indicated by an asterisk (*) after the scientific name. The common names of the fishes are given in all cases; those in local use are distinguished by quotation marks.

This list is only preliminary, as the available specimens and information do not warrant a full discussion of the District fish fauna at this time. It is contemplated to issue a second list, with illustrations of all the species and detailed notes on their habits, distribution, and abundance, as soon as the material can be collected. To this end the cooperation of anglers, commercial fishermen, fish-dealers, and students is asked in furnishing specimens and notes, for which full credit will be given.

PETROMYZONIDÆ. The Lampreys.

1. **Petromyzon marinus** Linnæus.* *"Lamprey"; "Lamper Eel"; "Sucker"; Sea Lamprey.*

Not common. Comes from salt water in spring and runs up streams to spawn. Shad are sometimes taken with lampreys 6 to 14 inches long hanging on their sides. Large ones, 1½ to 3 feet long, ascend small streams with the branch herring. Fishermen make it a point to kill the lamprey whenever there is an opportunity, as it is of no economic value and is regarded as destructive to other fish.

GALEIDÆ. The Requiem Sharks.

2. **Carcharhinus obscurus** (LeSueur).* *Dusky Shark.*

Occasionally observed in the Potomac between Fort Washington and Alexandria during dry weather when the water becomes brackish. An example 5 feet long, taken at Glymont in August, 1894, was examined by us in Center Market, where a cast of the specimen is now exhibited. Other sharks have also been taken in sturgeon nets at Glymont during dry weather, and many years ago one was captured at Fort Washington.

ACIPENSERIDÆ. The Sturgeons.

3. Acipenser sturio Linnæus.* *Sturgeon.*

Once abundant in the Potomac, but now comparatively rare. Ascends the river in spring to spawn. Large numbers were formerly caught in seines and gill nets by the shad and herring fishermen, who regarded sturgeon as nuisances and usually knocked them in the head and threw them away. The fish now commands a high price.

4. Acipenser brevirostris LeSueur.* *Sturgeon; Short-nosed Sturgeon.*

Not so abundant as the common sturgeon, and has undergone the same decrease in recent years. Probably not recognized by fishermen as a different species from the foregoing.

LEPISOSTEIDÆ. The Gars.

5. Lepisosteus osseus (Linnæus).* *"Gar Pike"; "Gar."*

Common in Potomac River and tributaries, especially Eastern Branch, Four-Mile Run, and Little River, but less numerous now than fifteen years ago. In former years shad gill-net fishermen often carried little clubs with which to kill the gars that became entangled in their nets. A destructive, fish-eating species, ascending creeks in summer after small fish. Food value very inferior; the expression "Common as gar broth" is proverbial.

SILURIDÆ. The Catfishes.

6. Ictalurus punctatus (Rafinesque).* *Spotted Cat; Blue Cat.*

This very desirable species of catfish has been introduced by the Fish Commission, small plants of adult and yearling fish being made in 1889, 1891, and 1892 in tributaries of the Potomac at Quantico, Va., Woodmont, Md., and Hagerstown, Md. On April 13, 1899, two live specimens, about a foot in length, were brought to the Fish Commission from the Potomac at Washington.

7. Ameiurus catus (Linnæus).* *"Channel Cat"; "White Cat."*

Abundant in channels of Potomac River. A valuable food-fish, many being taken by net fishermen and anglers. Attains a length of 2 feet.

8. Ameiurus nebulosus (LeSueur).* *"Mud Cat"; "Yellow Cat"; Bullhead; Horned Pout.*

Generally abundant in Potomac River and tributaries. Spawns along muddy flats and shores. Much less valuable for food than the channel cat.

9. Ameiurus natalis (LeSueur).* *"Stone Cat"; Yellow Cat.*

Occurs in Potomac River and Rock Creek. Less common than other members of this genus.

10. Schilbeodes insignis (Richardson).* *"Poison Cat"; "Mad Tom"; Stone Cat.*

Common in sluggish, muddy waters and also on rocky bottoms. A vicious little fellow, often caught with the hook, and capable of inflicting a painful wound with the pectoral spines.

CATOSTOMIDÆ. The Suckers.

11. Carpiodes cyprinus (LeSueur).* *Carp Sucker; American Carp; "Carp"; Quillback.*

Not very common except in circumscribed areas. Sometimes brought to the city markets, but not a highly esteemed food-fish. Locally called "carp." Reaches a length of 18 or 20 inches.

12. Catostomus commersonii (Lacépède).* *"Sucker"; Brook Sucker; White Sucker; "Fine-scaled Mullet"; "Bay Mare."*

Very common in the Potomac and in the tributary creeks. Found in our waters at all seasons, but taken chiefly in winter with seines and fykes. A poor food-fish, weighing 1 or 2 pounds. Bites freely at the hook baited with a worm, and is often caught by youthful anglers.

13. Catostomus nigricans LeSueur.* *"Stone-toter."*

Common in Potomac, Rock Creek, and other tributaries, but less so than formerly; prefers clear, rapid waters. Many are caught for market with seines in creeks, from December to April. Regarded as a fair fish for that time of year. It is said to carry stones on its flat head, whence the local name.

14. Erimyzon sucetta (Lacépède).* *"Chub"; Chub Sucker; Creek Fish; Creek Sucker.*

Found in the Potomac River and its tributaries generally, but is not abundant. In fall and winter it resorts to headwaters of streams. Frequently eaten and considered a good winter fish, being the best of the suckers for the table. Maximum weight, 1 pound.

15. Moxostoma macrolepidotum (LeSueur).* *"Mullet"; "Red Mullet"; Redhorse Mullet.*

Very common in the Potomac, where it reaches a weight of 2 pounds. Many caught in shad seines in the river below Washington; some taken with the shad, but the bulk of the run is after the shad season. The fishermen say that "when the red mullet come the shad fishing is over for seines."

CYPRINIDÆ. The Carps and Minnows.

16. Cyprinus carpio Linnæus.* *Carp; German Carp; Asiatic Carp;* varieties, *Leather Carp* and *Mirror Carp.*

Introduced from Europe, and now very abundant in the Potomac and the canal. Large quantities are sent to the city markets from the adjacent parts of the Potomac. Many weighing from a few ounces to 30 pounds are caught by anglers from wharves and the Long Bridge.

17. Carassius auratus (Linnæus).* *"Goldfish"; "Silver-fish"; "Sand Perch."*

Introduced from Europe and now common in the river and its principal tributaries, interbreeding with the carp. Chiefly valued as an aquarium fish; a few are sold for food in Washington markets under the name of "sand perch."

18. Tinca tinca (Linnæus).* *Tench.*

Introduced from Europe by the Fish Commission; escaped into the Potomac and now becoming common. Some are sent to market from District waters. Readily distinguished by its rich, greenish-brown color and very fine scales.

19. Idus idus (Linnæus).* *Golden Ide; Golden Orfe.*

Introduced from Europe and escaped into the Potomac from the United States Fish Commission ponds. A handsome, hardy aquarium fish and a fair food-fish, having a length of about a foot.

20. Hybognathus nuchalis Agassiz.* *"Gudgeon"; "Smelt"; "Silvery Minnow"; Smelt Minnow.*

Abundant in the Potomac and tributaries. Many caught by anglers from the city wharves and along the sea-walls of the reclaimed flats. Reaches a length of 6 inches, but averages only 4 inches.

21. Semotilus corporalis (Mitchill).* *"Fallfish"; "Chub"; Dace.*

This, the largest native cyprinoid fish of the District, is not uncommon in the clear tributaries of the Potomac, especially Rock Creek. It is often caught with hook and line in the smaller streams, but has little value as a market fish. It attains a length of 18 inches and a weight of nearly 5 pounds, but none so large has been observed in our local waters.

22. Semotilus atromaculatus (Mitchill).* *Horned Dace; "Fallfish"; "Chub"; Silver Chub.*

Common in tributaries of Potomac and in upper waters of Patuxent near Laurel, Md. The maximum size is 10 to 12 inches.

23. Leuciscus vandoisulus Cuvier & Valenciennes.* *Minnow; Long-mouthed Minnow.*

This beautiful minnow is found in the creeks of the District, but it is not abundant. It has been collected in the Northwest Branch, Berry Run near Glenwood Cemetery, and Accokeek Creek near Bryan Point, Maryland. In the last-named stream it has been found in some numbers. It is interesting to note that the sixth entry in the large catalogues of the fish collection of the United States National Museum registers a specimen of this species taken in District waters by Prof. S. F. Baird.

24. Leuciscus margarita (Cope).* *Minnow.*

This showy little fish inhabits clear creeks. It is less common than the preceding species.

25. Notemigonus crysoleucas (Mitchill).* *"Roach"; "Sunfish"; "Dace"; "Bitterhead"; Shiner; Chub; Bream.*

One of the most abundant and best known of our minnows, readily recognized by its uniform golden or brassy color. It frequents waters with bottom overgrown with grass or other vegetation. Examples a foot in length have been taken. The smaller fish are excellent bait for black bass.

26. Notropis procne (Cope).* *Minnow.*

A few specimens of this diminutive minnow, whose maximum length is only $2\frac{1}{2}$ inches, have been taken in Little River. It probably occurs in other suitable places.

27. Notropis hudsonius amarus (Girard).* *Spawn-eater; Silver-fin; Shiner.*

Common in the Potomac. Type was obtained at Washington and described by Dr. Girard in 1856.

28. Notropis analostanus (Girard).* *Silver-fin; Satin-fin; Lace-fin.*

Common in the Potomac River and tributaries. The type was described by Girard in 1856 from specimens taken at Analostan Island, after which the species was named.

29. Notropis cornutus (Mitchill).* *Shiner; Dace; Redfin.*

Abundant in small streams, such as Rock Creek, Northwest Branch, Cameron Run near Alexandria, and other tributaries of the Potomac. A valuable bait-minnow for bass and perch.

30. Notropis photogenis (Cope).* *Silvery Minnow.*

Apparently rare. A few specimens were taken in the Potomac at Washington in December, 1877, by Mr. William Palmer; and some years ago several were collected near Falls Church, Va., in Delaney Run, a branch of Little Hunting Creek, by the same collector.

31. Rhinichthys cataractæ (Cuvier & Valenciennes).* *Long-nosed Dace; Black-nosed Dace; Black Minnow.*

Inhabits cold, clear streams. Apparently not common.

32. Rhinichthys atronasus (Mitchill).* *Dace; Black-nosed Dace; Brook Minnow.*

Abundant, especially in small, spring streams tributary to Rock Creek. An active little fish of beautiful coloration. There is a black lateral band extending from snout to tail; in males in spring this band, together with the lower fins and sometimes the entire body, is bright crimson.

33. Hybopsis kentuckiensis (Rafinesque).* *"Chub"; "Horny-head"; Grass Chub; River Chub; Indian Chub; Jerker.*

Usually common on grassy bottom in the Potomac and tributaries. A very good bait-fish for bass, rockfish, and perch. Reaches a length of 9 inches.

34. Exoglossum maxillingua (LeSueur).* *Cut-lips; Butter Chub.*

Found in clear streams at foot of rapids, and in feeders of the canal. Not uncommon in places. A small species, remarkable for its 3-lobed lower jaw.

ANGUILLIDÆ. The Eels.

35. Anguilla chrysypa Rafinesque.* *Eel.*

Abundant. In spring the young, about 3 inches long, ascend the river, large straggling schools being seen along the rocky shores above Georgetown; these have come from salt water, where they were hatched. Large numbers are caught by commercial fishermen and anglers. An omnivorous feeder, very destructive to spawn of shad and other fish.

DOROSOMATIDÆ. The Gizzard Shads.

36. Dorosoma cepedianum (LeSueur).* *"Gizzard Shad"; "Virginia Shad"; "Mud Shad"; Hickory Shad; Winter Shad.*

Fairly common in the Potomac at all seasons, but scarcer now than formerly. Sold in the markets, but not highly esteemed as food. Spawns in summer. Average weight, 1½ to 2 pounds.

CLUPEIDÆ. The Herrings and Shads.

37. Pomolobus mediocris (Mitchill).* *"Hickory Shad"; "Hickory Jack"; "Tailor Shad"; "Fresh-water Tailor"; Fall Herring; Tailor Herring; Mattawacca.*

Common. Comes in spring with the branch herring; a few remain in upper river through summer and fall. Used as food, but not highly esteemed; sometimes sold to the unwary as true shad, from which it is readily distinguished by its projecting lower jaw. Largest weigh 4 pounds, the average 2 pounds.

38. Pomolobus pseudoharengus (Wilson).* *"Herring"; "Branch Herring"; "Blear-eye"; River Herring; Alewife.*

Very abundant, but less so than formerly. Ascends the river in early spring, in advance of the shad, usually reaching District waters about March 1, but sometimes by the middle of February.

39. Pomolobus æstivalis (Mitchill).* *"Glut Herring"; "River Herring"; Summer Herring; Alewife.*

Very abundant, reaching this part of the river in spring a little later than the shad. A trifle larger than the branch herring, from which it is readily distinguished by its black peritoneum. Next to the shad this is the most important food-fish of the District waters, large numbers being sold fresh and also salted at the fishing shores.

40. Alosa sapidissima (Wilson).* *Shad.*

This valuable food-fish ascends the river in spring, usually reaching the District about April 1. The upper limit of its range is the Great Falls, where numbers are taken by means of long-handled dip nets, the fishermen standing on the rocks. It is the object of extensive fisheries carried on with seines, gill nets, and pound nets, and is the most highly esteemed and important food-fish of these waters. Its abundance in the Potomac is chiefly dependent on artificial propagation, as a very large part of the run each season is caught before the fish have reached their spawning-grounds in fresh water. The average weight of males or "bucks" is 3 pounds and of females or "roes" 4½ pounds.

41. Brevoortia tyrannus (Latrobe).* *Menhaden; "Bugfish"; "Alewife."*

This salt-water fish is a straggler within the District, occasionally ascending the river in dry weather as far as Fort Washington. At Bryan Point, Maryland, several hundred were taken at one seine haul in June, 1892.

ENGRAULIDIDÆ. The Anchovies.

42. Stolephorus mitchilli (Cuvier & Valenciennes).* *Anchovy.*

Many specimens of this salt-water species have been taken in fall in the river channel off Bryan Point, Maryland, by the Fish Commission.

SALMONIDÆ. The Trouts and Salmons.

43. Salvelinus fontinalis (Mitchill). *Brook Trout; Speckled Trout.*

In former years this fish inhabited Difficult Run, on the Virginia side of the Potomac below Great Falls, but was supposed to have been long since exterminated. Recently, however, a few have been taken in this stream. In all probability it also formerly occurred in the cooler tributaries of Rock Creek.

UMBRIDÆ. The Mud Minnows.

44. Umbra pygmæa (DeKay).* *Mud Minnow.*

Frequents ditches and sluggish streams; very abundant in Eastern Branch and in ditches along the Washington and Ohio Railroad. Common in streams and ditches about Laurel, Md. Often found in water so shallow and foul that no other fish could live in it. Length, 3 to 4 inches.

LUCIIDÆ. The Pikes.

45. Lucius americanus (Gmelin).* *"Pike"; Banded Pickerel.*

Not uncommon in Little River and other tributaries of the Potomac with grassy bottom. Length, 12 inches or less.

46. Lucius reticulatus (LeSueur).* *"Chain Pickerel"; "Pike"; Federation Pike; Eastern Pickerel.*

More or less abundant in Potomac River and tributaries on the grassy bottoms of coves and creeks; also found in the canal. Scarcer than formerly. Quite a number are sold in the Washington markets, brought from the river contiguous to the city. The fish reaches a length of 2 feet.

PŒCILIIDÆ. The Killifishes.

47. Fundulus heteroclitus (Linnæus).* *"Minnow"; "Pike Minnow"; Killifish; Mummichog; Mud Minnow.*

Very abundant in the Potomac and its larger tributaries. Important as food for other fishes and as a bait for anglers.

48. Fundulus diaphanus (LeSueur).* *"Minnow"; Killifish.*

Abundant. A showy minnow, usually found ascending the shallow streams of the District in the spring and early summer months, loitering under bridges and starting out with great energy when startled by the noise of foot passengers or vehicles; in their fright they sometimes swim on shoal sandy bars and become stranded. A valuable bait-fish.

49. Cyprinodon variegatus Lacépède.* *Sheepshead Minnow; Variegated Minnow.*

A brackish-water species, rarely straying within our limits; once taken at Gunston Wharf, Va., by Col. M. McDonald, in spring of 1881.

ESOCIDÆ. The Marine Gars.

50. Tylosurus marinus (Walbaum).* *"Silver Gar"; Salt-water Gar; Needle-fish; Billfish.*

This salt-water fish is a regular visitant, coming in spring with the branch herring and remaining throughout the summer. It ascends the river as far as the Aqueduct Bridge. Usually observed swimming at the surface in scattered bodies. At times it is a nuisance to anglers on account of its bait-stealing habits.

SYNGNATHIDÆ. The Pipefishes.

51. Siphostoma fuscum (Storer)*. *Pipefish.*

A straggler from salt water, once taken at Gunston, Va.

PERCOPSIDÆ. The Trout Perches.

52. Percopsis guttatus Agassiz.* *Trout Perch; Sand-roller.*

This species is not abundant, so far as known, and has up to this time been taken only in Rock Creek and Cabin John Run.

APHREDODERIDÆ. The Pirate Perches.

53. Aphredoderus sayanus (Gilliams).* *Pirate Perch.*

Professor Baird has reported that he saw a specimen of this fish from the Potomac many years ago. Recently found at Laurel, Md., by Mr. George Marshall, of the U. S. National Museum.

ATHERINIDÆ. The Silversides.

54. Menidia beryllina (Cope).* *Silverside.*

This species was described in 1866 by the late Professor Cope from specimens taken in the Potomac near Washington. It is more or less common in the vicinity of Long Bridge and the mouth of Four-Mile Run.

CENTRARCHIDÆ. The Basses and Sunfishes.

55. Pomoxis sparoides (Lacépède).* *"Strawberry Bass"; "Strawberry Perch"; "Crappie"; Calico Bass; "Speckled Perch."*

56. Pomoxis annularis Rafinesque.* *"Crappie"; Bachelor.*

Both of these species were introduced into the Potomac River and the Chesapeake and Ohio Canal by the Fish Commission in 1894, and have become very common in places, noticeably Little River, Four-Mile Run, Eastern Branch, and in the river near Seven Locks; also throughout the canal as far as Harpers Ferry. *P. annularis* is the more abundant here. These are excellent game and food fishes and many are now caught by anglers. The two species are much alike and not usually distinguished by local fishermen, who apply the names "crappie," "strawberry bass," "strawberry perch," and "speckled perch" indiscriminately.

57. Ambloplites rupestris (Rafinesque). *Rock Bass; Red-eye Perch; Goggle-eye.*

Not native, but introduced by the United States Fish Commission in the Patuxent River near Laurel, Md., and in Rock Creek in the fall of 1894. Also distributed to individuals for pond culture in the District and adjoining parts of Maryland.

58. Chænobryttus gulosus (Cuvier & Valenciennes).* *Warmouth; Red-eye Perch; Goggle-eye.*

Introduced into the Potomac by the Fish Commission about 1895, and apparently becoming common in a few places. First specimen was taken December 4, 1897, in Little River. In 1898 five were caught in Four-Mile Run.

59. Eupomotis gloriosus (Holbrook).* *Blue-spotted Sunfish; Little Sunfish.*

This very pretty sunfish frequents sluggish waters with aquatic vegetation. Specimens have been taken in Roach's Run, where it is fairly common, and in the Government fish ponds near the Washington Monument. Maximum length about 3 inches. An attractive and hardy aquarium fish.

60. Enneacanthus obesus (Baird).* *Little Sunfish.*

Found under the same conditions as *E. gloriosus*, but not so common.

61. **Lepomis auritus** (Linnæus).* *"Sunfish"; "Tobacco-box"; Long-eared Sunfish; Sun Perch; Bream; Redbreast.*

This is a common and well-known fish, often caught by anglers. It abounds in the Potomac, Rock Creek, Eastern Branch, and other waters, preferring eddies and holes with sandy bottoms. In winter many are caught with nets and sent to market.

62. **Eupomotis gibbosus** (Linnæus.)* *"Tobacco-box"; "Sunfish"; Bream; Pumpkin-seed.*

Abundant in the Potomac and all its principal tributaries, spawning and rearing its young along the shores with sandy bottoms, in which depressions are made for the better protection of the eggs, the parent fish carefully guarding eggs and young. Well known for its gameness and beauty of coloration, which make it the joy of youthful anglers. Below Washington many are caught in winter with nets and sent to the city markets.

63. **Micropterus dolomieu** Lacépède.* *"Black Bass"; "Small-mouthed Black Bass."*

More or less abundant throughout the Potomac River between Washington and Harpers Ferry; not common below Washington. This well-known and highly esteemed game fish is not a native of District of Columbia waters, but was introduced in the Chesapeake and Ohio Canal from the Ohio River about 1854 and thence reached the Potomac.

64. **Micropterus salmoides** (Lacépède).* *"Black Bass"; "Large-mouthed Black Bass"; "Chub"; Oswego Bass; Green Bass; Trout; Jumper; Welshman.*

Introduced in Shenandoah River in 1889 by the Fish Commission, and later plants were made in the lower Potomac, with the result that by 1896 the fish had become remarkably abundant in the vicinity of Washington, and it is now taken in large numbers by anglers and net fishermen. In the winter of 1898–99 many thousand pounds were caught with nets in Mattawoman, Occoquan, and Piscataway creeks and sent to market. One fisherman sent 1,700 pounds to market at one shipment.

PERCIDÆ. The Perches and Darters.

65. **Perca flavescens** (Mitchill).* *"Yellow Perch"; "Yellow Ned"; Ringed Perch.*

One of the most abundant food and game fishes of the District. Caught in large numbers with nets and also taken by anglers. Found in the city markets chiefly in winter and spring. Usually with well-developed roe at that time, spawning taking place in March or April. A handsome and hardy aquarium fish.

66. **Percina caprodes** (Rafinesque).* *Log Perch; Hog Molly.*

This large darter is not uncommon in gravelly streams of the District. It takes the hook freely and is sometimes caught by boys fishing from the city wharves.

67. **Hadropterus peltatus** (Stauffer).* *Shielded Darter.*

Not common. Recorded many years ago from a tributary of the Potomac in Anne Arundel County, Maryland, and from the upper Patuxent. Recently taken in Laurel, Md., and above the Long Bridge, on the Virginia shore of the Potomac.

68. **Boleosoma olmstedi** (Storer).* *Darter; Johnny Darter.*

Represented in District waters by a slight variety called *atromaculatus* by Dr. Girard. The common darter of this region, abundant in clear running streams. A good aquarium fish.

69. **Boleosoma effulgens** (Girard).* *Darter; Tessellated Darter.*

This species was based on eight specimens collected in Rock Creek by Professor Baird and described by Dr. Girard in 1859. It has since been recorded from the Little Falls, Rock Creek, and the headwaters of the Patuxent River, near Laurel, Md. It frequents rocky bottoms in rapid water, and is an interesting aquarium fish.

SERRANIDÆ. The Sea Basses.

70. **Roccus lineatus** (Bloch).* *"Striped Bass"; "Rockfish"; "Rock."*

Common in waters of the District, ascending the Potomac as far as Great Falls. Found here at all seasons, but most abundant in spring and summer. In former years Little Falls was a favorite resort for anglers in quest of this fish; there Daniel Webster, Thaddeus Norris, and other prominent persons made good catches. Size, game qualities, and food value make this one of our best fishes. "Rock" weighing as much as 90 pounds have occasionally been taken near Washington and examples of 20 to 60 pounds' weight are not uncommon.

71. Morone americana (Gmelin).* *"White Perch"; "Silver Perch."*

Abundant in the Potomac and tributaries, ascending the river as far as the Great Falls. A favorite with anglers, many of good size being taken in the channel of the river from Long Bridge to Little Falls. Some white perch are found in District waters at all seasons, but the principal run occurs in spring, the fish spawning here in April and May. Feeds on the spawn of shad and other fish, also on insects, minnows, young eels, etc.

HÆMULIDÆ. The Grunts.

72. Orthopristis chrysopterus (Linnæus).* *Pigfish; Hogfish; Red-mouthed Grunt.*

A straggler from salt water; young pigfish were once taken at Gunston, Va.

SCIÆNIDÆ. The Drums.

73. Leiostomus xanthurus Lacépède.* *Spot; Goody.*

Young spots have occasionally been taken at Gunston Wharf, Va., and at Mount Vernon, during dry weather.

74. Menticirrus saxatilis (Bloch & Schneider). *Kingfish; Whiting; Sea Mink.*

The young of this salt-water species were obtained by Colonel McDonald at Gunston Wharf, Va., in the spring of 1881.

EPHIPPIDÆ. The Angel-Fishes.

75. Chætodipterus faber (Broussonet).* *Angel-fish; Spadefish; Moonfish.*

Rarely straying in the Potomac as far as Gunston Wharf, Va., where Col. Marshall McDonald secured the young in 1881.

COTTIDÆ. The Sculpins.

76. Cottus meridionalis (Girard). *Miller's Thumb; Blob; Muffle-jaw; Bullhead.*

Reported years ago from the Potomac. Observed in recent years by Mr. William Palmer in a stream above Great Falls, on the Virginia shore.

77. Uranidea gracilis (Heckel). *Miller's Thumb; Blob.*

Recorded from Rock Creek many years ago. No specimens recently taken.

GOBIIDÆ. The Gobies.

78. Gobiosoma bosci (Lacépède).* *Clinging Goby.*

In the spring of 1881 a number of specimens of this goby were taken by Col. M. McDonald at Gunston Wharf, Va.

BATRACHOIDIDÆ. The Toadfishes.

79. Opsanus tau (Linnæus).* *Toadfish; Scorpion; Oyster-fish.*

This salt-water species is entitled to a place in this list by having been once obtained at Gunston Wharf, Va.

TRIGLIDÆ. The Sea-Robins.

80. Prionotus carolinus (Linnæus).* *Sea-robin; Gurnard.*

Several young specimens of the sea-robin were caught at Gunston Wharf, Va., in the spring of 1881.

SOLEIDÆ. The Soles.

81. Achirus fasciatus Lacépède.* *American Sole; Hog-choker.*

Young specimens have been taken in Eastern Branch, Four-Mile Run, and Little River. Adults are common in spring on the fishing shores below Washington, but have not been observed in the immediate vicinity of the city.

NOTES ON A COLLECTION OF TIDE-POOL FISHES FROM KADIAK ISLAND IN ALASKA.

By CLOUDSLEY RUTTER,
Assistant, United States Fish Commission.

The collection on which the following report is based was made by the writer in May, 1897, mainly at Karluk, Kadiak Island, Alaska. The beach there is composed of bowlders more or less overgrown with fucus and kelp, or of coarse gravel, and is exposed to the open sea, there being no harbor. In some places the tide recedes as much as 100 yards, in which case there are a few true tide pools. Most of the fishes, however, were obtained among the bowlders. Just west of Karluk Head are a few good tide pools, and there a new species of *Neoliparis* was found.

Uyak Bay contains a number of good collecting-places, one near the Pacific Steam Whaling Company's cannery and another near the mouth of Larsen Inlet. At both places the rocks are cavernous, and good pools, with seaweed, are left at low tide. Many specimens were obtained at the foot of an island on the east side of the bay, where a broad rocky beach is exposed at low tide.

Some collecting was done in Alitak Bay, at the southern end of Kadiak Island, but it is a very unsatisfactory place.

The collection is now in the museum of Leland Stanford Junior University, where it was studied.

The descriptions of the new genus and species, which this collection contains, were first published in Jordan & Evermann's Fishes of North and Middle America.

Notes on the fresh-water *Cottus* and the sticklebacks found in Karluk and Alitak lakes are included.

1. Pygosteus pungitius (Linnæus). *Nine-spined Stickleback.*

Two specimens from a brook near the mouth of Alitak Bay agree with the variety *brachypoda* in having the dorsal spines X–I and in having the ventral spines one-third length of head, but it may be that the same tendency to variation exists in this species as in the following species of *Gasterosteus*, in which case the shortening of the spines in fresh water will hardly justify systematic distinction.

2. Gasterosteus cataphractus (Pallas). *Stickleback.*

Common in the lakes and in Karluk estuary. From Karluk estuary 157 specimens were obtained, which show all possible gradations between the typical *cataphractus*, with its long, slender, and fully armed body, slender and acute spines, narrow pubic plate and thoracic area, and the form heretofore known as *microcephalus*, with its heavy and but partly armed body, short, heavy spines, and broad pubic plate and thoracic area. Of the 157 specimens 35 have the sides but partly plated, and only about as many more can be distinctly classed as typical *cataphractus*. Those of the lakes are all of the form *microcephalus*.

The two southern forms will have to be known as *Gasterosteus cataphractus microcephalus* and *Gasterosteus cataphractus williamsoni*. It seems evident that specimens typical of *microcephalus* are independently derived from the parent species in different localities. It seems more probable that the parent species has entered the fresh water in California and at Kadiak Island and independently changed into the fresh-water form in the two places than that the variety has kept distinct from the parent species while migrating from one place to the other. It is even more probable that the parent species has entered the two lakes, Karluk and Alitak, on Kadiak Island, and produced the fresh-water form independently, than that the variety

has kept distinct from the parent species while migrating from one lake to the other through salt water. The name *microcephalus* therefore becomes a mere convenience, and does not represent a true variety.

The form known as *williamsoni* is limited in its distribution, and, so far as is now known, represents a true variety. To put these forms in their true relation the name *microcephalus* would have to be abandoned and the forms represented by it considered as transitional between the species *cataphractus* and the variety *williamsoni*.

3. **Cottus aleuticus** Gilbert.

Found in Karluk River and Lake and in Alitak Lake. Common. The following table shows the measurements of eleven specimens from the two lakes, the head and depth being expressed in hundredths of the body. Length of specimens from 1.8 inches to 2.7 inches, the caudal fin not included.

Head.		Depth.		Dorsal.		Anal.	
No. of specimens.	Proportion of body.	No. of specimens.	Proportion of body.	No. of specimens.	No. of rays.	No. of specimens.	No. of rays.
1	0.29	1	0.19	10	IX-19	1	12
6	0.30	4	0.20	1	IX-20	6	13
2	0.31	5	0.21			4	14
2	0.32	1	0.23				

4. **Myoxocephalus polyacanthocephalus** (Pallas).

Common at Karluk; often taken in the seine when fishing for salmon, but not often found in the rock pools. The following are measurements of two specimens, the head and depth being expressed in hundredths of the body:

	Specimen 2 inches long.	Specimen 13 inches long.
Head	0.44	0.46
Depth	0.27	0.22
Dorsal	X-15	X-14
Anal	13	12

5. **Leptocottus armatus** Girard. Not very common. Only two specimens found at Karluk.

6. **Oligocottus maculosus** Girard.

Oligocottus borealis Jordan & Snyder, Proc. Cal. Ac. Sci. 1896, 225, Neah Bay, Washington. Common at Karluk.

SIGMISTES Rutter.

Sigmistes Rutter, in Jordan & Evermann, Fishes of North and Middle America, part III, 2863, 1898 (*caulias*).

This genus differs from *Oxycottus*, to which it is most closely related, in the deep, compressed body, strongly arched lateral line, long dorsal fin, and large mouth; body deep and compressed; skin smooth; lateral line strongly arched anteriorly; gill membranes united, free from isthmus; no slit behind last gill; preopercular spine simple, short, strongly curved upward; anal papilla large; vent immediately behind ventral fins, about three-fifths of distance from gill membrane to anal fin; ventrals, 1, 3.

(*σίγμα*, the letter *s*, from the form of the lateral line.)

7. **Sigmistes caulias** Rutter.

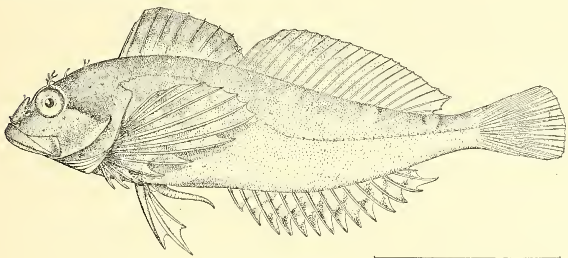
Sigmistes caulias Rutter, in Jordan & Evermann, Fishes of North and Middle America, part III. 2863, 1898, Karluk, Alaska.

Head 3.4; depth 3.5; D. IX, 20 (IX, 21 in one specimen); A. 15 (14 in two specimens); P. 13, Back elevated, body compressed; eyes lateral, 4.34 in head; snout 3.50; cleft of mouth lateral; maxillary 2 in head, reaching to below pupil (only a little past front of eye in one specimen); teeth coarse, cardiform, the inner row of upper jaw enlarged, almost canine-like; a pair of similar teeth near symphysis of lower jaw; a small patch on vomer, one on front of palatines; preopercular spine small, sharp, appressed, strongly curved upward, the preopercular margin without spines or tubercles below it; nostrils in tubes, one pair directly behind nasal spines, the other lateral, directly in front of eyes; nasal spines strong, sharp; a pair of tufted cirri above eyes, a pair simple or branched at occiput, and a pair of simple cirri halfway between

these; a filament on nasal spines; a series of three or four short filaments on margin of preopercle and at opercular angle; a series of pores around under side of jaw and along edge of preopercle, two concentric series under eye and across cheek, and others scattered on head behind eye and across cheek; skin smooth, lateral line strongly arched. Dorsal fins connected at base, third spine longest, 2.75 in head, margin of fin even from third to sixth spines, origin of spinous dorsal over upper edge of gill-opening; soft dorsal higher, longest rays 2 in head, its base two-fifths length of body; tips of anal rays free, longest 2.34 in head; origin of anal under third ray of soft dorsal; longest pectoral ray a little longer than head; caudal truncate, 1.5 in head; ventral about reaching anal, about same length as anal papilla; tail slender, least depth slightly less than eye, length from anal 1.80 in head, its length from dorsal about equal to its depth. Color in life pale-pinkish, spinous dorsal dusky, nearly black along the margin, soft dorsal plain, or with dusky crossbars; anal with about seven dusky crossbars, extending downward and forward almost at right angles to the rays; three or four pale blotches surrounded by a black ring along base of dorsal, one between dorsals, one at end of soft dorsal and others at base of soft dorsal (some or all sometimes absent); a curved dark line from snout through eye to preopercular spine.

Six specimens, 1¼ to 3 inches long, from rock pools at Karluk, Alaska. The type is in Leland Stanford Junior University Museum, No. 5884; cotypes are in United States Fish Commission and United States National Museum.

Καύλος, stem, from the many dorsal rays.



Sigmistes caulias Rutter.

8. Oxycottus acuticeps (Gilbert).

Common in the rock pools at Karluk. Largest specimen taken, 2.5 inches. Slate color, varying to pink; pectoral with cross blotches around the margin; anal papilla very large, tridigitate at tip; female with a free membrane around vent. The following are measurements on nine specimens 1.6 to 2.1 inches long, not including caudal fin, the head and depth being expressed in hundredths of the body.

Head.		Depth.				Dorsal and anal fin formulæ.					
		Male.		Female.		Spinous dorsal.		Soft dorsal.		Anal.	
No. of specimens.	Proportion of body.	No. of specimens.	Proportion of body.	No. of specimens.	Proportion of body.	No. of specimens.	Rays.	No. of specimens.	Rays.	No. of specimens.	Rays.
1	0.27	1	0.23	1	0.24	8	VIII	1	14	3	11
2	0.28	2	0.24	2	0.27	1	IX	3	15	4	12
4	0.29			2	0.28			5	16	2	13
2	0.30			1	0.29						

9. Porocottus bradfordi Rutter.

Porocottus bradfordi Rutter, in Jordan & Evermann, Fishes of North and Middle America, part III, 2862, 1898, Karluk, Alaska.

This species differs from *Porocottus sellaris* in the presence of cirri on top of head; it has more numerous fin rays and more cirri on head than *Porocottus quadrifilis*.

Head 3; depth 3.75 to 4.25; eye 4; D. IX, 15 or 16; A. 11 to 13; P. 13 or 14; B. 6. Head broad, somewhat depressed; bones of head cavernous; lower jaw included; maxillary to below middle or hinder edge of pupil, 2.34 in head; teeth in jaws and in a narrow crescent on vomer; eye equal to snout; nasal spines blunt, covered by the skin, no ocular, opercular, nor suprascapular spines; preopercular spines three, upper slender, curved upward; lower straight, pointing downward; middle one short, blunt, a mere tubercle; a very slight tubercle represents the fourth spine belonging to the genus; no slit behind last gill; three pairs of cirri on top of head, one above eye multifid, another at occiput single or bifid, the other between them trifid to multifid; a minute barbel on tip of maxillary; whole top and side of head, lower jaw, and edge of preopercle thickly covered with pores; a double series of pores, 34 to 36 each, along lateral line, many accessory pores arranged in groups of one to five between the pairs of the lateral line, the larger number anteriorly; nostrils with short tubes; dorsals united at base, the spines with short filaments, middle spines 3 in head, middle rays of soft dorsal 2.5 in head; caudal and ventral three-fifths in head, ventrals usually reaching vent or anal, but sometimes falling short of both; pectoral three-fourths of head, reaching to or beyond anal. Color dusky, colorless below, a pale bar across occiput (often absent), another between dorsals, two across body under soft dorsal, and another behind soft dorsal; sometimes the pale portion predominates and the dusky portion is left as four bars, sometimes plain dusky without bars; spinous dorsal dusky with three or four colorless spaces on web; other fins barred with series of dusky blotches, ventrals sometimes colorless; five to eight oval white spots behind pectoral, sometimes obscure; males with inner ray of ventrals tuberculate or serrate.

The most common fish in the rock pools at Karluk.

The type is in Leland Stanford Junior University Museum, No. 6063; cotypes are in the Fish Commission and the U. S. National Museum.

Named for Mr. William B. Bradford, secretary of the Alaska Packers' Association.

Dorsal.		Anal.	
No. of specimens.	Fin rays.	No. of specimens.	Fin rays.
11	IX, 15	1	11
12	IX, 16	22	12
1	IX, 17	2	13
1	VIII, 17		

10. Neoliparis callyodon (Pallas). Very common at Karluk and Uyak Bay.

11. Neoliparis rutteri Gilbert & Snyder.

Neoliparis rutteri Gilbert & Snyder, in Jordan & Evermann, Fishes of North and Middle America, part II, 2108, 1898, Uyak Bay, Kadiak Island, Alaska.

Rare; three specimens from Karluk and three from Uyak Bay. The species is distinguished from *Neoliparis callyodon,* with which it is found, by the large size of the ventral disk, fewer rays of dorsal and anal, and the elevated spines of the male.

12. Pholis ornatus (Girard). Common at Karluk, Uyak Bay, and Alitak Bay.

13. Anoplarchus atropurpureus (Kittlitz). Crest well developed; color very dark, markings indistinct. Common at Karluk, Uyak Bay, and Alitak Bay.

14. Gymnelis viridis (Fabricius).

Head 6.5 to 7; depth 10 to 11; eye equal to snout, 4.34 to 5 in head; maxillary reaching to posterior margin of eye, 2.2 to 2.5 in head; D. 90 to 98; A. 70 to 77; B. 5.

Body long and slender, compressed; width of head equal to its depth, 1.75 in its length; interorbital space narrow, width of bone less than half length of eye; teeth strong, blunt, a single series in side of each jaw, none on vomer or palatines; pseudobranchiæ small; pectoral broad, nearly circular when spread, 2.50 in head; dorsal even, its height, measured vertically, 1.50 times eye; anal half as high as dorsal, both confluent with caudal; ventrals wanting. Plain olive, paler below; an irregular white stripe along side of head under eye from middle of maxillary to preopercle; often one or more small round black spots on dorsal, but at no definite portion, these usually not occurring in individuals with the white stripes on cheeks.

Numerous specimens from Karluk, the longest about 4.25 inches. One specimen has the depth 14, maxillary slightly more than 2 in head; width of head 1.2 in its depth, 2.34 in its length; upper ray of pectoral 1.5 times lower ray. Length 4.25 inches.

THE SOUTHERN SPRING MACKEREL FISHERY OF THE UNITED STATES.

By HUGH M. SMITH.

The southern spring mackerel fishery of the United States is important from several standpoints, and of late has been especially interesting, for well-known reasons to be hereafter referred to. While always much less extensive than the regular fishery for mackerel carried on during the summer and fall months, it has nevertheless, in past years, engaged a large fleet of vessels from various New England ports; has at times proved a remunerative industry to large numbers of fishermen and vessel-owners, and has yielded an important addition to the food supply of some of the principal coast cities of the East and indirectly to an extended area of the country. In 1886–87 this fishery was brought prominently into public notice by the agitation of the question of its suspension and by the passage by Congress, in February, 1887, of an act prohibiting the prosecution of the fishery for a period of five years, beginning March 1, 1888. The action taken by Congress in this matter must ever remain notable in the annals of our national legislative history, in that it was one of the extremely rare instances in which the Federal Government has essayed to regulate the fisheries.

The expiration in 1892, by limitation, of the law enacted by Congress again brought this fishery into prominence during the year 1893, and its renewal constituted one of the most noteworthy features of the fishery industry during the latter year, and reopened a very important subject, having interest for the legislator, the economist, the fish-dealer, the fish-protector, the fish-culturist, the commercial fisherman, and the general public.

Still further interest has recently attached to the fishery because of its long-continued unsatisfactory condition and the discussion of further restrictive measures on the part of the United States and Canada.

It is the purpose of this paper to give a short account of the history and importance of this fishery, to show the reasons for its prohibition by Congress, to present a summary of its results in the first year of its renewal and in subsequent years to 1898, and to consider some of the questions suggested by its suspension and renewal. Quotations are freely made from Congressional and other official records in order to contribute to a fuller knowledge of the various phases of this subject.

EARLY HISTORY OF THE FISHERY.

Precise information showing the circumstances attending the origin of the spring seine fishery for mackerel in southern waters is lacking. Vessels fishing with hook-and-line had been accustomed to go south in the spring from a very early period. As early as 1817 it is recorded that a Rockport, Mass., vessel of 35 tons burden went as far south as Cape May and landed 60 barrels of fish caught by drailing.

An old mackerel fisherman, who went south two years later, is quoted as follows:

I commenced mackerel fishing in 1819; built a pinkey and went south; chopped our bait; worked sometimes all night; called 125 to 150 barrels a good trip for three or four weeks; sold no mackerel fresh in those days; all salted. The first trip was usually sold in New York; the next one brought home to Gloucester.

From that time, for a period of thirty or forty years, larger or smaller numbers of vessels sailed south annually from Gloucester, Provincetown, Newburyport, Annisquam, and other places. In 1859, however, it was announced that "the practice of going south for mackerel has almost died out of late years, and this year there are but three or four vessels in the business."* About this time the purse seine began to be a rather common form of apparatus in the capture of mackerel, and the southern spring fishery was resumed and became more extensive than ever before.

In the early days of this fishery all of the vessels engaging therein were fitted out with salt and barrels and landed their fish in a salted condition at the principal New England ports. Occasionally vessels fishing in the vicinity of New York landed fares of fresh fish in that city, but the custom of salting practically all of the catch continued to be observed uninterruptedly until a comparatively recent date, gradually giving place, in the later years of the fishery, to a directly opposite practice. New York proving to be a reliable market for fresh mackerel, and the price received being such as to warrant the fishermen in selling their fish fresh, the owners of the vessels began to encourage their crews to dispose of as much of their catch in that way as the market would take. This action was influenced by the well-known fact that has since been much discussed, that the spring mackerel is a better food-fish when fresh than when salted, and that the fish packed in the southern fishery, owing to their poor quality, never commanded the price or had the demand that the mackerel taken later in the year did. The practice became more general, until at the time of the suspension of the fishery, and for a number of years preceding that event, most of the vessels engaged in the business with the intention of selling their entire catch fresh, while a few fitted out with a limited supply of salt and barrels to enable them to care for small quantities of fish that would not warrant a run to market unless in the immediate vicinity of port. In lieu of the former outfit, the vessels employed in the fresh-mackerel fishery were provided with large ice-bins in which to store the fish and a supply of ice with which to preserve them prior to arrival at the market.

For a great many years prior to 1860 the smacks of Connecticut and New York engaging in the line fishery for cod, bluefish, and other species to supply the markets of New York City, made a practice of taking mackerel in the spring when the schools were in the vicinity of Sandy Hook, and of preserving them alive in their wells while running to the city, where they were transferred to the live-cars of the dealers pending sale. This fishery was never very extensive and was discontinued about 1860.

During the next five years the receipts of fresh mackerel at New York were very small, but about 1865 vessels sailing from Gloucester began to land occasional fares taken off Sandy Hook and by 1870 from twenty to thirty cargoes of fresh mackerel were brought in annually, although most of the southern fleet continued to salt the catch and carry it to the various New England ports. It is recorded that in 1872 the schooner *Dreadnaught*, of Portland, Me., was fitted with a purse seine to engage exclusively in the southern fresh-mackerel fishery and was the first vessel that did not

* Cape Ann Advertiser, May 20, 1859.

carry salt for preserving a part of the catch. On April 20, 1872, this vessel landed 10,802 mackerel at New York, which netted the fishermen $1,372.05. This first trip was followed by others, and the vessel closed the spring fishery with a large stock. The success of the *Dreadnaught* caused other vessels to fit out with purse seines the following year, and soon the seining fleet became quite large.

The first vessels landing fresh mackerel in New York took the fish with jigs, and the daily catch was comparatively small; and as the fish had to be carried to market soon after being caught, in order to arrive in a fresh condition, the fares were correspondingly small. After the introduction of the purse seine the jiggers were placed at a disadvantage, and in a short time the jigging fleet discontinued the selling of fresh mackerel in New York, leaving the trade exclusively to the vessels carrying seines, which often caught several hundred barrels at a single haul and had a cargo of perfectly fresh fish to take to market.

The number of cargoes of fresh mackerel landed in New York was at times so large that the market was often overstocked, and it then became necessary to find other outlets for the catch. Philadelphia came to be the headquarters of a small fleet, and the larger cities of southern New England also received the product of some of the vessels. The trade, however, was always practically controlled by New York, and from 70 to 90 per cent of the output was annually handled in that city.

With the growth of the fishery and with increased facilities for handling the fish the range of distribution of the catch has been much extended. While a large percentage of the mackerel has always been consumed locally in New York, Brooklyn, Jersey City, and the other cities adjacent to the metropolis, considerable quantities have been shipped to Baltimore and Washington in the South, to Chicago and occasionally Denver in the West, and to Boston, Portland, and Canada in the North. In order to deter the decomposition of the fish it has been found desirable to gib those intended for shipment to more distant places, and this commendable practice is now universally adopted. Gibbing consists in removing the gills and abdominal viscera without opening the fish, the parts being drawn out through the gill-cavity by inserting one or two fingers under the gill-arches. After being eviscerated the fish are packed in barrels containing an abundance of ice, and usually reach their destination in a good state of preservation.

The schools of mackerel usually approach the coast of the United States in the latter part of March or early in April, and are generally first seen by the fishermen off the coast of North Carolina, in the region of Cape Hatteras. The principal part of the fleet sails in time to meet the fish off the capes of Virginia or south of Cape Henlopen. The fish are followed northward along the shore until they reach the neighborhood of Block Island and No Man's Land, when the southern spring fishery may be said to be over. The mackerel have often made their advent in immense schools, pursued by the concentrated fleet, and from 50 to 100 vessels have been observed within an area of 20 square miles.

There is some rivalry among the fishermen as to who shall obtain the first fare, which is heightened by the knowledge that the first vessel to arrive in port will find an excellent market and have ready sale at very high prices. In calm weather the desire to reach New York when a cargo is obtained sometimes leads fishermen to charter a tug at points far down on the New Jersey coast, but this is usually deferred until the neighborhood of Sandy Hook is reached, from which place towage to the city may be had for $15 or $20.

Vessels sometimes run into New York without a tug, but the large number of vessels in the lower and upper bay and harbor makes the passage unsatisfactory and even dangerous. A short distance below the city the fishing vessels usually leave their boats at the ice-houses built to supply this fishery and make arrangements for taking ice aboard on their return from market. The average-sized vessel carries 10 tons of ice, valued at about $2.50 a ton. The vessels are accustomed to stop at the docks near Fulton Market, where the dealers act as agents for the fishermen in selling the fish, charging 12½ per cent commission on gross sales. At the time of the suspension of the fishery in 1887 about 75 or 80 per cent of the business was in the hands of three dealers. Owing to the perishable nature of the fish, and the great importance to the fishermen of being on the fishing-grounds, the vessels are unloaded with all possible haste, half of the crew being employed in the hold in counting the fish into baskets and half carrying the fish from the vessel to the dealers' stalls or to the carts of peddlers; the captain and the agent of the dealer remain on the deck and keep an account of the fish as they are landed.

The first fresh mackerel are usually landed in New York during the first week in April; fares have, however, been brought in as early as March 22. When once the fishery has regularly begun, the vessels arrive in quick succession, and in fifteen or twenty days the fishery is at its height. The fishery continues without special change until the 15th or 20th of May, when a part of the fleet withdraws from this branch, returns home, and refits for the summer fishing. By June 1 the fish have gone as far north and east as Block Island, and the season at New York is over, the vessels taking fresh fish after that time usually landing them in Boston.

The fish are always sold by number and not by weight. The price naturally varies with the supply, size, and season. During the few years elapsing before the suspension of the fishery, the first fish to arrive usually brought about 10 cents each. When the market has been glutted, the price has fallen to a ridiculously low figure, sometimes only 50 cents a thousand. Reference is made elsewhere to large quantities thrown away in 1885 on account of an oversupply.

It is somewhat singular that, although New York has always controlled the trade in fresh spring mackerel, that city has never had a vessel engaging in the fishery. The fishery has been carried on wholly by New England vessels, which go south for a limited period in the spring, then refit with barrels and salt in place of bins and ice, cruise for mackerel on the New England shore, the coast of Nova Scotia, and in the Gulf of St. Lawrence, landing a certain part of the catch fresh in Boston, Gloucester, and Portland when taken sufficiently near port to warrant it.

THE FISHERY IN 1885, 1886, AND 1887.

The history of this fishery during the two or three years immediately preceding its suspension is of very great interest to fishermen, legislators, and others, and may be appropriately referred to at some length in this place. While most of the information that can be given has already become a matter of history, and is well known to the fishing interests, it is chiefly to the results of the fishery during these years that one must look for the reasons which finally led to the suspension of the business by Congress.

In 1885 the fleet started south at the usual time. The schooner *Mollie Adams*, of Gloucester, sailed March 4, which is reported to be the earliest recorded date for the beginning of this fishery. On March 28 the first fares of fresh fish were landed in

New York by the schooners *Emma W. Brown* and *Nellie N. Rowe*, of Gloucester; the cargo of each vessel was about 125 barrels. The *Nellie N. Rowe* had been the first to land fish in the two preceding years, arriving at New York March 31, 1883, and March 24, 1884. Enormous bodies of small mackerel were found off our coast during most of the season, and unusually large quantities were landed at New York and Philadelphia. About 175 vessels engaged in the fishery. The most active or fortunate ones landed as many as seven fares, while the average number of trips for the fleet was four or five. Probably not less than 850 trips, all told, were made to New York; these averaged from 140 to 150 barrels each, so that during the season about 125,000 barrels of fresh mackerel were landed in that city, this quantity representing about 31,250,000 fish. The large catch was considerably more than the dealers could handle and resulted in a serious glut in the market. As many as 130 vessels were in port with fish at one time, and the price had to be placed at a surprisingly low figure in order to dispose of them. Many fish at this time sold as low as 50 cents per 1,000, while large numbers were thrown away. The average price for the season was between 75 cents and $1 per 100 fish; taking the mean, it is seen that the value of the fish landed in New York was about $273,500. The fish caught during 1885 were comparatively small; the average number required to fill a barrel was 250. The supply was unusually constant, there being only one week when storms interfered with fishing.

Much has been said and written about the quantity of mackerel that had to be thrown away during the remarkable glut mentioned. It was stated at the time, and has been repeated in recent years, that the waste, which was enormous, amounted to 40,000 or 50,000 barrels in the judgment of some, and to as much as 100,000 barrels according to others. While the circumstances attending the waste made it extremely difficult to form a close approximation of the quantity of fish involved, and afforded good ground for extravagant statements, yet the personal observations made at the time by the agents of the United States Fish Commission, confirmed by reliable authorities, showed that there was really little foundation for these high estimates, and indicated that only from 10,000 to 15,000 barrels of fresh mackerel were thus destroyed for want of a market, and that the most liberal estimate should not place the quantity at over 20,000 or 25,000 barrels.

In 1886 about 150 vessels prosecuted this fishery. The first vessel sailed from Gloucester March 11, and in a short while there was a large fleet off the Delaware coast. The fish were first observed in a large body in latitude 37° 30′, longitude 75° 35′, on March 28, when the first catch was made. For more than three weeks the mackerel remained in this region, and as late as May 15 a small fare was taken there. About the middle of May large schools of fish were noticed in latitude 38° 30′, longitude 74°, and good fares were taken for about a week. During the height of the season there was a period of about twenty days when stormy weather caused the suspension of the fishery to the very serious detriment of the fishermen. The quantity of fish landed in New York was much less than for a number of years; the fishery was almost a failure, and the greater part of the fleet failed to pay expenses. Perhaps half the vessels failed to secure any fish, and many of the others did not take enough to offset the expense of outfitting. Prior to the 1st of June 117 cargoes of fresh mackerel were landed in New York. These represented 2,739,370 fish, and sold out of the vessels for $78,507. The fares averaged 106 barrels, or 23,415 fish. The prices ranged from $1.50 to $10 per 100 fish, the books of the dealers showing $2.90 as the average. The fish, as a rule, were somewhat larger than for several years, the average weight being rather more than ¾ pound, or 78 pounds to 100 fish.

The first vessel to arrive at New York with mackerel was the schooner *Ellen M. Adams*, of Gloucester, which landed 125 barrels, or 22,500 fish, on April 12. The last arrival was the schooner *E. F. Willard*, of Portland, which reached New York May 26. The largest number of vessels in port in any one day was 28 on April 24. On April 25 there were 13 fares landed, on April 27 there were 10, and on April 29 there were 11. On no other day were more than 7 cargoes landed.

During the spring of 1886 from 20 to 25 fares of fresh mackerel were received at Philadelphia, averaging about the same as those landed in New York; 5 or 6 cargoes were landed in Providence, and a few trips were made to other cities, including one to Boston consigned to New York dealers, and one to Norfolk for shipment to New York.

In addition to the fresh fish taken in 1886, about 2,000 barrels of salt mackerel were landed in New York before June 1 by vessels engaged exclusively in the salt-mackerel fishery, and 500 more barrels were landed by vessels employed principally in taking fresh fish.

The spring of 1887 found the fish-dealers with an exceptionally light stock of salt mackerel, consequently the fishermen were eager to start south, and the outcome of the fishery was watched with unusual interest. The first vessel sailed March 11, and by the height of the season about 106 schooners had entered the fishery. The fleet fell in with the mackerel unusually late, the arrival of the schools perhaps being delayed by the continuance of wintry weather far into spring. The first mackerel appear to have been taken on April 8 off Cape Charles, Va., by the U. S. Fish Commission schooner *Grampus;* these fish were caught in gill nets. The first fare was landed at New York on April 23, and consisted of 10,000 medium-small fish caught two days earlier by the schooner *Caroline Vought*, 50 miles off Hog Island, Va. There were nine other arrivals at New York during the last week of April, aggregating 195,750 fish, mostly small, the largest fare, 70,000, being brought in by the schooner *Nellie N. Rowe*. The prices were low, ranging from 2½ to 6 cents per fish.

During May there were 87 arrivals of fresh mackerel at New York and Philadelphia, the fares aggregating 6,736 barrels, or 1,347,100 fish. The largest single trips were 200 barrels, which quantity was taken by each of the schooners *Sarah P. Ayer*, *Mollie Adams*, *Clara S. Cameron*, *Margaret Smith*, *Nellie N. Rowe*, and the steamer *Novelty* (a converted menhaden steamer).

In the first half of the month the fish were found between Cape Charles and Cape May. Later the fleet followed the rapidly moving schools on the New Jersey and New York coasts. The mackerel were, for the most part, of small and medium size, and the prices were rather low, owing to the great abundance of shad in the markets; the fishermen realized from 12 cents to one-half cent per fish, according to size. Several good fares of fresh fish were also taken to Boston; thus, on May 23, the steamer *Novelty* and the schooner *Mollie Adams* each landed 350 barrels from the coast of New Jersey and New York, the sales being from $8 to $1.50 per 100 fish.

A feature of the fishery was the landing of comparatively large quantities of salt mackerel at New York, Philadelphia, and various New England ports. The first fare, taken to New York on May 6, consisted of 30 barrels and sold for $7 a barrel. Other arrivals at New York and Philadelphia comprised 2,720 barrels, having a value of $19,401, the prices per barrel ranging from $6.25 to $9.50. The salt mackerel landed at New England ports, chiefly Gloucester, amounted to 1,982 barrels and yielded the fishermen $13,792. An interesting trip of salt mackerel was that of the schooner *Edith Rowe*, which reached Gloucester May 24, with 350 barrels, caught 100 miles south

of Georges Bank, in latitude 39° 18′ north, longitude 70° 10′ west, a region seldom visited by mackerel fishermen.

In the 1887 southern mackerel fishery, the total catch was about 1,674,600 fresh fish, or 8,384 barrels, with a market value of $53,402, and 4,732 barrels of salt fish, valued at $33,403. The average stock per vessel engaged was $504 on fresh fish and $315 on salt fish. The total number of trips of fresh fish was 100, and the average fare was 84 barrels.

SUSPENSION OF THE FISHERY BY CONGRESS IN 1887.

An account of the agitation immediately leading up to the consideration by Congress of the southern spring mackerel fishery and its suspension by that body, constitutes a very interesting and important chapter in our fishery history. In order to more fully and accurately cover the subject, the principal features of the discussion are presented quite fully, including certain correspondence not before made public.

The question of prohibiting this fishery seems to have first been generally discussed in 1885, and it appears to have originally emanated from the fishermen and fish dealers of Maine. It was no doubt suggested by the large catch of mackerel in 1885, elsewhere referred to, which resulted in a great waste of fish and in glutting the fresh-fish market, and which also had an unusually depressing effect on the salt-fish trade. Even before the close of the mackerel season the subject seems to have received the serious attention of some of the persons most interested, and on December 1, 1885, the mackerel fishermen and dealers of Portland, Me., sent the following letter and petition to the United States Commissioner of Fish and Fisheries, through a prominent wholesale dealer:

[Mr. A. M. Smith, Portland, Me., to the Commissioner of Fish and Fisheries, December 1, 1885.]

It is the judgment of owners of vessels and the men who man them that it would be greatly to the interest of all people who are interested in the mackerel fishery, both as owners and consumers, that there should be a law enacted by the United States prohibiting the importation of such fish by the inhabitants of the United States or of any other nation or their dependencies, if such fish are caught between February and June of each year, which I think is the spawning season for mackerel; and the Portland Fishery Exchange have taken the initiative in the matter and have appointed a committee, of which I have the honor of being chairman, to draw up a heading for signature, to a petition for the consideration of Congress, and it occurred to me that before submitting the same I would send the rough draft of same for your consideration, and ask if you would kindly offer any suggestions that may occur to you as to the best way to get at the matter.

It has seemed to me that the petitions which we send ought to go through your honorable body of commissioners, and if meeting with your indorsement would more likely meet with attention of Congress. We would also like very much to know your idea of the subject, and if it meets with your approval. We, as a community of fishing interests, are under great obligations to you for your interest in the fishing questions, and especially as opposed to free fish, and trust this question of early South mackereling will also receive your careful consideration and, if meeting with your favor, your influence in bringing about the consummation so devoutly to be wished for.

[Draft of petition from Portland Fishing Exchange asking Congress to prohibit mackerel fishing between December 1 and June 1.]

Whereas it does appear to all interested in the fishing industry of the Atlantic coast of the United States that the catching of mackerel before they are allowed sufficient time to spawn, for which purpose the said fish come upon the coast of New England and Nova Scotia from about May 1 to June 15, [is injurious] and believing as we do that the tendency of catching such fish during said spawning season is to depreciate the quality and quantity of such fish and to drive them from our own shores; and

Whereas we believe that the only way in which this industry can be preserved and the good quality and quantity of such fish maintained, is by the enactment by the United States of laws prohibiting the landing or importation into the United States by their own citizens, or the citizens of any other nation or its colonies, of any mackerel caught between December 1 and June 1 of any year beginning January 1, 1885:

Therefore we, the undersigned, engaged in said industry in our several relations of owners of vessels, fishermen employed on such vessels, and others directly interested in this industry, do hereby respectfully request that the United States Fishery Commissioners do urge upon our next Congress the necessity and desirability of such protection by suitable and sufficient legislation.

From this beginning the agitation of this question spread throughout the fishing communities of the Atlantic coast and even into the interior of the country. Petitions to Congress, similar in phraseology to the one quoted, were circulated and very extensively signed by fishermen, fish-dealers, vessel owners and fitters, and other classes of citizens.

The opposition to the continuance of this fishery, which developed in 1885 and finally resulted in the passage of a prohibitory act by Congress, chiefly originated with or was pressed by dealers in salt fish and vessel-owners engaged extensively in the salt-mackerel fishery. A majority of the fresh-fish dealers were not in favor of any legislation at that time affecting this fishery. A small percentage of the dealers in fresh fish agreed with the salt-fish dealers as to the desirability of suspending this fishery; and, on the other hand, a few salt-fish men sided with the larger number of fresh-fish dealers.

The arguments presented by those who favored the abolition of this fishery were numerous and varied, and for the most part not referred to or suggested in the petitions sent to Congress or in the act which finally became a law. Among other objections to the fishery the following were urged in substance:

First. This fishery is extremely uncertain and has usually been carried on at a loss from its origin to the present time. A few vessels each year have done well, and, in a few instances, the same vessels have year after year been successful, but a great deal of money has been lost by the dealers and fitters, and the fishery is, at best, little more than a lottery. The vessel-owners are reluctant to place their vessels in an enterprise which experience has taught to be so uncertain, but the chances for a good season are often too strong to be resisted by captains and crews, and the owners, often against their better judgment, fit out for the fishery. The captains, who are frequently part owners, are anxious to get to work, and their views have to be considered; even when captains have no pecuniary interest in the vessels, if they are efficient and have made money for the vessel-owners in the past, their wishes have to be regarded, as other firms of vessel-owners might offer them vessels for this fishery and thus secure their services permanently.

Second. The continued catching of mackerel on so large a scale before the fish have spawned will ultimately result in the exhaustion of the supply and the practical destruction of the mackerel fishery.

Third. The continual harassing of the fish by so large a fleet of seiners early in the season interferes with their migrations along our shores, breaks up the schools, prevents spawning, and drives the great body of mackerel from the New England coast, where they would be caught after they had deposited their spawn and grown fat. The catch on the northern part of our coast later in the year is thus seriously interfered with, the tendency of the seines being to keep the fish off the United States coast and to cause them to enter the Gulf of St. Lawrence.

Fourth. The fish taken in the southern spring mackerel fishery are of very inferior quality, and not really wholesome food when eaten fresh; furthermore, fish salted at this season are of decidedly poor quality as compared with those caught farther north later in the season.

Fifth. Some of the dealers claim that putting large quantities of fresh mackerel on the market interferes with the trade and reduces the prices for salt mackerel. The salt-fish dealers are almost unanimously of the opinion that in former years, and to a less extent recently, the landing of poor salt mackerel caught and packed during this southern fishery has had a depressing influence on the trade in salt mackerel, in that it prejudices the consumers against salt mackerel in general as a diet; further, the arrival of new salt mackerel in New York early in the season and the announcement to the trade that new mackerel have arrived, diminishes to a very large extent the sale of old mackerel and causes great difficulty in working off the stock which has been held over from the previous season, necessitating a reduction in price in order to dispose of it.

Sixth. Those favoring the suspension of the fishery were not united as to the length of time the fishery should be discontinued each season. While the possibility of the mackerel not completing the spawning process by June 1 was generally acknowledged, objection was made to an extension of the close season to July 1 or later, on the ground that the fisherman would not be content to remain idle so late in the year and that the vessels should start by that time in order to get an idea of the location, movements, and abundance of the fish. It was urged as an argument that the fishery after the 1st of June would not seriously interfere with the future abundance of the fish, that during the spawning season the fish are usually scattered and at the bottom, and that there is little probability of the vessels taking great quantities at this period.

Most of these arguments for the prohibition of the fishery were combated by those who favored its unrestricted continuance. The opposition to the proposed legislation was based chiefly on the following grounds:

First. Congressional interference with the ocean fisheries establishes a dangerous precedent. To prevent the capture of a pelagic fish that moves about freely in the ocean and whose habits are not fully understood, and to attempt the application to the high seas of the usual fish and game legislation, are serious steps.

Second. There is no indisputable evidence that catching mackerel in spring, or at any other time, affects the general abundance of the fish. Prohibition of this fishery should not be resorted to without positive proof of the necessity for such action. The contention is not established that the use of purse seines or the prosecution of this southern fishery is having the effect of changing the direction of the movements of the schools and is driving them from our shores.

Third. The limitation of the close season to June 1 rather than to the end of the spawning time shows the insincerity of those who urge that legislation is necessary for the preservation of the fish. To have any appreciable influence on the protection of the mackerel prior to spawning, the close time should be extended to July 1 or even to July 15.

Fourth. Fresh mackerel taken in this fishery form a cheap, wholesome food for thousands of people who can not afford to buy the higher grades of fish. The low price of mackerel in seasons of abundance is a great boon to a large part of the population.

Fifth. The argument of the salt-fish dealers that placing on the market poor salt mackerel caught at this season causes a depression was said to have no foundation, as the recent practice of selling the fish fresh in New York has become so general that not enough fish are salted to have any influence on the trade, and further, the fishermen are deterred from salting large quantities of spring mackerel because the fish are poor, and if salted must be sold at a low price.

Sixth. The proposed law would be severe and sectional in that it would prevent the taking of mackerel on one part of our coast by citizens of certain States simply to allow them to proceed to other parts of the coast, where they could be caught without restriction.

Very full consideration was accorded the subject by the appropriate committees of Congress. The matter first took definite shape when, on February 8, 1886, a bill (No. 5538) embodying the wishes of the petitioners was reported by the House Committee on Ways and Means. The text of the bill, which was afterwards amended in several important respects, was as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the period of five years from and after the passage of this act no mackerel, other than what is known as Spanish mackerel, caught between the first day of March and the first day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores.

SEC. 2. That section 4321 of the Revised Statutes is amended, for the period of five years aforesaid, so as to read before the last sentence as follows: "This license does not grant the right to fish for mackerel, other than for what is known as Spanish mackerel, between the first day of March and the first day of June, inclusive, of this year." Or in lieu of the foregoing there shall be inserted so much of said period of time as may remain unexpired under this act.

SEC. 3. That the penalty for the violation or attempted violation of this act shall be forfeiture of license on the part of the vessel engaged in said violation, if a vessel of this country, and the forfeiture to the United States, according to law, of the mackerel imported or landed, or sought to be imported or landed.

SEC. 4. That nothing in this act shall be construed to conflict with existing treaties.

SEC. 5. That all laws in conflict with this law are hereby repealed.

Accompanying this bill was a report made by the Committee on Ways and Means, to which the petitions had been referred. The report is interesting as showing the manner in which the petitions were regarded and the wishes of the petitioners interpreted by the committee. The most important part of the report is that in which the object of the proposed legislation is stated to be the prevention of the capture of mackerel during the spawning season. The report is as follows:

The committee are not entirely certain of their jurisdiction over the subject-matter of the petitions; but as the subject was referred to them by the House, and the question of jurisdiction may be, at best, a matter of doubt, they concluded, without wishing to arrogate to themselves the functions of others, to report a bill.

The bill herewith submitted is designed to meet the wishes of the petitioners, who are mostly those engaged in the mackerel fishery; and their wants appear to be identical, in this case, with the general interests of the people. The object is to prevent the catching of mackerel during the spawning season, and thereby save this exceedingly important food supply from threatened extinction upon our shores, the methods now employed in the business being much more liable to produce this result, if indiscriminately exercised, than were those formerly used. The principle of this bill is that which usually underlies the game laws.

As early as 1660 efforts were made to prevent unseasonable depredations upon this fish, which was then called by the commissioners of the United Colonies "the most staple commodity of the country." In 1670 "the court of the Massachusetts" prohibited the catching of mackerel, except in a very restricted way, before the 1st of July of each year. This, however, seemed to carry the

restriction too far, and it was repealed in 1692, but only to be virtually reenacted at a later period in the same year. Other legislation followed from time to time.

That the mackerel continued to abound, and the industry of catching them to increase, is to be accounted for rather by the fact that it is not an an anadromous fish and by reason of the primitive devices of the day, than because of the laws of the period. In 1831 the catch reached its maximum, being 449,950 barrels. It then steadily fell off each year until in 1883 it was only a little over 138,000 barrels. With varying fortune it fell in 1877 to nearly 127,000 barrels. Each period of decline in the catch, and consequently of comparative exemption from molestation of this fish, has apparently led to the hatching and maturity of sufficient numbers to fully restock our waters. Thus in 1881 the catch rose again to over 391,000 barrels.

By far the most valuable fishing-grounds for mackerel, since the introduction of the purse seine and similar appliances for taking them, are along our northeastern coasts. With these devices they are freely taken as soon as they appear after the winter season is over. Their condition, until June or July when the spawning is mostly over, fits them only for the eager demand for fresh fish.

The only available market is our own. If fishermen are denied this market at that season they will have no occasion to take the mackerel. The proper season for catching does not begin before the 1st of June, and it usually continues until about the 1st of November, when the fish disappear for the winter. The bill will not affect the revenue receipts, nor is it in conflict with existing treaties.

It is believed that the proposed legislation will prove an adequate test of measures deemed by many to be imperatively needed at this time, and the committee recommend the passage of the bill.

The bill came up for consideration in the House of Representatives on May 20, 1886, and evoked one of the most interesting discussions concerning the fisheries that ever took place in that body. Every phase of the subject was touched upon by the advocates or opponents of the measure; the legal and constitutional questions involved were brought out, the habits of the mackerel were discussed, the early history of the fishery was revived, authorities in this and other countries were quoted, the necessity for protecting the mackerel was debated. The entire proceedings are worthy of perusal, and the following abstract of the discussion, although somewhat extensive, may appropriately be printed. The bill having been called up by Mr. C. R. Breckinridge, of Arkansas, that gentleman spoke as follows:

Mr. BRECKINRIDGE, of Arkansas. Mr. Speaker, this bill has been presented by the Committee on Ways and Means in response to numerous petitions referred to the committee, as well as urgent representations by gentlemen of the House who are well informed on this subject. The object of the bill is to prevent mackerel fishing when the fish are first moving to our shores and for the most part are spawning. Gentlemen are familiar with legislation of this kind relating to other species of fish, and the general nature of the measure will be apparent, perhaps, without much explanation from me.

It may be well to remark that the committee proposes two amendments, one of which arises from the lapse of time since the introduction of the bill. The bill as drawn proposes to embrace the present season as one during which mackerel caught in the early part of the season can not be landed. That period having substantially passed, the bill, of course, can only begin to operate with the coming year.

There is also one section, section 4, which has been inserted by mistake, and which at the proper time I will ask to have stricken out. That section provides that "Nothing in this act shall be construed to conflict with existing treaties." Upon inquiry at the State Department we have learned that this provision is unnecessary verbiage.

Mr. Speaker, I would not consent to any extreme and permanent legislation upon a matter of this sort; but a conservative proposition like this, temporary in its duration, is, I think, only a reasonable response to the views and solicitations which have been presented to us. The bill can only operate for five years; and it will only preclude, so far as it may be effectual, the catching of mackerel during a period of three months of each year, mainly the spawning season, when, as is well known, so far as the salting of fish is concerned, they are ill suited for that purpose.

There is considerable doubt among the authorities as to whether or not any appliances for catching fish that rove in the open sea can have an appreciable effect upon their quantity. I am less of opinion now than I was in the earlier stages of such investigation as I have been able to give

to this matter, that it is possible to practically exterminate open sea fish. But, as I before remarked, there is considerable difference of opinion on this subject, especially in view of modern appliances dealing with classes of fish that congregate closely in great schools and upon limited areas. By means of immense nets operated by steam, fish are now taken, not as in olden times by hook and line, but as many as hundreds of barrels at a single haul.

But apart from that, a matter about which there is practically no dispute is the unwisdom of their being harassed in the early part of the year and during the spawning season by being pursued, as they sometimes are, by five hundred or more vessels, plowing among them and dispersing them from our coast, driving them far out to sea where it is difficult to get them and, of course, much more expensive to dispose of them after they are caught. Especially is this realized in the warm season of the year—and the mackerel fishing season proper is mainly from about the 1st of July to the 1st of November, running through the warm months of July and August—when the fish are taken at a point remote from shore, and when there must, of course, be more expensive arrangements made for preserving them until they can be properly handled.

Therefore, sir, the concurrent testimony being that, independent of the question of extinction, while the fish are coming into our shores and during this earlier portion of the season embracing at least a greater part of the spawning season, they should not be disturbed, and should not be harassed until fully upon our fishing-grounds and fitted for consumption, I have come to the conclusion (without myself knowing by experience anything at all of this business, but after conferring with those who have experience and from reading the productions of those who are considered authorities upon the question) that the passage of a bill of this character is a reasonable and conservative step, and so far as food products are concerned will tend to cheapen the supply of food. I am all the more strengthened in my support of this measure because it seems to be in accord with the almost unanimous wish of the men who catch the fish and see the need of some regularity and system.

It may be well to remark that of the fleet we have engaged in this business, 358 vessels in 1885, carrying 5,425 men, all but four of the vessels came from the States of Massachusetts and Maine. Of those four, one comes from Portsmouth, N. H., one from Connecticut, one from Pennsylvania, and one from New York. I believe the principal opposition will come from my distinguished friend from New York [Mr. Hewitt], who, I suppose, represents that single vessel.

Mr. Reagan. Will my friend from Arkansas be kind enough to state (because I have not examined the bill) in what waters the bill proposes to control fishing?

Mr. Breckinridge, of Arkansas. We do not specify any waters in the bill. We can not do that. The bill seeks to prevent the landing of mackerel from the 1st of March to the 1st of June, wherever they may be caught, upon the theory that if people can not land and sell them they will not catch them.

Mr. Reagan. What I wish to ask the gentleman from Arkansas, in this connection, is if there is anything in the bill that applies to the waters within the marine league of the shore on our State coasts.

Mr. Breckinridge, of Arkansas. There is nothing in the bill that affects the waters within the marine league, at least no thought of interference is entertained, nor is there anything that applies to the fish caught in the estuaries along our shores.

Mr. Reagan. I asked the question because there was a bill referred to the Judiciary Committee for the purpose of extending to citizens of each State the rights granted to citizens of any other State to fish for floating fish——

Mr. Collins. They reported adversely on that bill.

Mr. Breckinridge, of Arkansas. This has no connection with that bill.

Mr. Reagan. That is what I understand, that the Committee on the Judiciary reported adversely as to the authority to do that. How, then, can authority be assumed to do it here?

Mr. Breckinridge, of Arkansas. But we do not touch that question; this has reference to deep sea fish. We do not say, or I do not wish to say, that citizens of the United States shall not catch fish within the jurisdiction of the State.

Mr. Reagan. But if you disregard the principle that the waters within the marine league belong to the States, and if this bill applies to such waters, then you do restrict the rights of the citizens of the State.

Mr. Reed, of Maine. We do not touch that question at all; this applies to the waters beyond the marine league.

Mr. Breckinridge, of Arkansas. This has reference, as the gentleman will observe, only to the fishing for mackerel, which do not run up the streams or come into the estuaries. They are an open-

sea deep-water fish, perhaps do not come within the marine league, or least of all during the season here embraced, and hence the point that the gentleman from Texas raises is perhaps not touched by this bill. But I will be glad to see any proper features that may be lacking added by the House.

Mr. REAGAN. But the gentleman from Arkansas must remember that the marine league extends a good way out from the estuaries.

Mr. BRECKINRIDGE, of Arkansas. I am aware of that, but I am stating the fact that these being what are termed open-sea fish do not come into the estuaries like shad and herring, and perhaps are not caught to any appreciable extent even within the marine league. Other gentlemen here can speak to that point better than I can.

Mr. COLLINS. And they do not catch them with a hook and line any more.

Mr. LORE. Let me ask the gentleman from Arkansas whether the Fish Commission of the United States has favored this bill?

Mr. BRECKINRIDGE, of Arkansas. I will state, in response to the gentleman from Delaware, that the Fish Commission of the United States has not been asked specifically about the bill, though I have talked fully with the Commissioner and others of the service, and had some correspondence with them about the propositions involved; and I have here in my hand a very interesting letter from the specialist employed by Professor Baird to study and observe the habits, etc., of the mackerel, Captain Collins, a gentleman whom I am assured by Professor Baird is the best living authority on the subject, and his statements of facts strongly sustain this bill.

Mr. TUCKER. I would like to ask the gentleman from Arkansas another question. In reading this bill it seems to me it does apply to waters which belong for the purpose of fishing to the States as well as the waters beyond the marine league or domain of the States.

Mr. BRECKINRIDGE, of Arkansas. Will the gentleman point out the provision of the bill to which he referred?

Mr. TUCKER. The second section of the bill.

Mr. BRECKINRIDGE, of Arkansas. Well, that I shall be glad to hear further upon; but I can not understand now how you can make such a construction.

Mr. TUCKER. I am asking only for information, not pretending to criticise the bill. The second section of the bill provides:

> That section 4321 of the Revised Statutes is amended, for the period of five years áforesaid, so as to read before the last sentence as follows: "This license does not grant the right to fish for mackerel, other than for what is known as Spanish mackerel, between the 1st day of March and the 1st day of June, inclusive, of this year."

Now, what is the nature of this license to which reference is made?

Mr. REED, of Maine. That is simply for the purpose of giving notice to the fishermen directly in their licenses.

Mr. TUCKER. Does this license, which the Government allows under this bill, apply to waters which belong exclusively to the States?

Mr. REED, of Maine. No, sir.

Mr. TUCKER. It applies, then, only to the ocean, or to waters beyond the marine league?

Mr. REED, of Maine. It applies only to such waters as the United States has the right to issue a license for.

Mr. REAGAN. It seems to me that this first provision of the bill is more indefinite than the other. By permission of the gentleman from Arkansas I want to call his attention to the reading of the first section:

> That for the period of five years from and after the passage of this act, no mackerel, other than what is known as the Spanish mackerel, caught between the 1st day of March and the 1st day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores.

There is nothing in this that would indicate that the bringing in of mackerel, caught within the territory of the States, may not be covered by this act.

Mr. REED, of Maine. It is not intended to cover it, and has not that effect.

Mr. TUCKER. I do not think it will cover it, for I take it for granted that the section applies only to mackerel caught in waters beyond the boundary of the United States.

Mr. REAGAN. It does not say so.

Mr. TUCKER. Yes; it says "shall not be imported," and that implies that it is caught in foreign waters; and therefore I think the first section applies only to fish caught in foreign waters.

Mr. HEWITT. Fish caught by American vessels in the deep sea and brought into our ports would not be classed as an importation under our customs laws and regulations.

At this point the debate drifted into parliamentary matters, and the consideration of the bill was postponed until the following day, May 21, when the following discussion ensued:

Mr. REED, of Maine. As this measure which is now before the House is one somewhat novel in its character, I feel it necessary that there should be a full, free, and frank explanation of the whole thing to the members of the House. In the first place, it concerns a very deserving class of people. It concerns between five and six thousand fishermen on the coast of Maine and Massachusetts, and New England generally. In a larger sense it concerns the whole of the people of the United States, because it is a food question as well as an industrial question. The class immediately concerned are at this time especially deserving of the attention of the House, not only because of what they have suffered under the unfortunate articles in the treaty of Washington, but also because to-day a difficulty exceedingly great and affecting them is springing up, causing them great damage and threatening more. The people who are engaged in the fisheries upon the northeastern coast, owing to the treaty of 1870, have been suffering severely in their person and estate in past times, and at this present time, unless there be the most careful and judicious management on the part of all concerned, there is likely to be greater suffering on their part and the beginning of trouble which will extend its effects all over the country. At this time and in behalf of this portion of our people, I present the provisions of this bill. And if I shall succeed, as I hope, in gaining the attention of the House and in satisfying the minds of the members that the request which I make is a reasonable one, the cause and objects of it will plead for me better than I can myself.

The mackerel fishery is one that has been very important to the people of this country in times past, and which can be made of equal importance in the times to come, if we judiciously attend to it. But there have been of late years a great falling off in the character of the catch and a great change in the nature of the fisheries, as I will demonstrate to you by figures. I hope to be able to point out to you the cause and also the remedy. In former years the mackerel used to be caught by a hook and line, and the result was that very fine fish were caught. But within the last ten years the nature of the fishery has changed very much. Instead of a hook-and-line fishery the purse-seine fishery has been developed, and instead of going into a school of mackerel and hauling out what could be brought out by hook and line, the fishermen of to-day, in larger craft, go out and surround the school of mackerel by nets which are placed vertically in the water and are floated by cork at the top edge. When the school is entirely surrounded the bottom edges of the net are drawn together into purse-like shape, and the result is that the whole body of fish, good, bad, and indifferent, are scooped up together, as if they were so much dirt.

Now, at a particular time any one can see that such a fishery may be specially disadvantageous to the increase of fish. There is a time when the fish thus caught are filled with spawn and with the future possibilities of the production of mackerel. All these fish are taken together; and while they are in the spawning condition—that is, while the spawn is forming within them—they are poor and almost unfit for food; they are very bad for food under all circumstances.

The proposition which I have to present to the House to-day is the same which has been put in operation in almost all the States with regard to the internal fisheries; that is, I propose that we shall have a close time which shall cover this period of spawning. I desire frankly to state any objections that there are, and I believe I know them all. It will strike you at first sight as if there could be nothing said against a proposition as reasonable as this is, to stop the destruction of fish in their spawning period when the reproduction of the fish is in very great peril. But there are arguments urged against it, and I am bound to say to you at the outset that our scientific men, Professor Baird and Professor Goode, express an opinion which I can best show by giving the opinion of Professor Goode, which is:

> I have never been convinced that the abundance of mackerel along our eastern coast has been in past years diminished through the agency of man. I am not therefore prepared to say that I believe that the prosecution of the spring mackerel fishing will lead to its own destruction.
>
> In a report on the history of mackerel, published in 1883 by the Commissioner of Fisheries, I reviewed the evidence at that time in existence, and I have not as yet seen any reason for changing the views therein expressed.

I should say to you there are other reasons besides these which I will develop, but I want to say distinctly that while Professor Goode says he does not know whether such a measure is necessary for that purpose or not, I am bound to say to you that every fisherman engaged in the business does know, and all of them are here before you, with hardly a dissenting voice, urging upon the ground of

their personal experience, that it will be the destruction of the fisheries not to have a close time, and I am prepared to show you that the lack of a close time already has been a very severe injury to the fishing industries of the United States.

All the fishermen present themselves here with their petitions for this bill. On the other hand, there is a single petition against it, and I will show you from what source that comes. It is the petition of the Fishmongers' Association of the City of New York. They are opposed to this legislation. I think I may say, without being accused of imputing unworthy motives to anybody, that they are opposed to it upon the salutary ground that commissions are good for people who sell. Of course they present one other ground, because people never reveal their selfishness utterly. The Fishmongers' Association say that they are struggling in the interest of cheap food for the people. Let us see precisely what this cheap-food cry means. Mr. Blackford, who is a New York fish commissioner, but who is also a dealer himself, gives a single instance of this cheapness of food which illustrates it all. He says:

> About the 1st of April the mackerel fleet struck an immense school of fresh mackerel, and they all loaded up and came into New York, and there was at one time upward of fifteen million mackerel lying around the wharves in the vicinity of Fulton Market. Those mackerel were unloaded there just as fast as possible. Men, women, and children came from all parts of the city with baskets and the wagons of licensed venders, and there was no question about the price. They gave a basketful for 5 or 10 cents and would load a wagon for 25 cents. For the space of two or three weeks the poorer classes had the benefit of this immense catch of mackerel. They were distributed all through the city. Of course, it was the means of a large class of people making money—not myself, although I am in the fish business.

What was the nature of this cheap food? Cheap things we want. It is a little hard sometimes on the men who furnish them that they should be so very cheap, but still we want cheap food provided it is also good food—not cheap and nasty, but cheap and good. What does Mr. Blackford himself say about the character of this food? He says:

> A large portion of these were salted, but at that season of the year the mackerel are inferior in fatness; the quality is not of a kind that makes them most desirable for salting.

Let me add one other fact in that connection, which is, that in order to supply that week or two of cheap food to the people in and around the city of New York, 100,000 barrels of mackerel filled with spawn were thrown into the ocean and could not be used—a destruction greater than the actual use that was made; for Mr. Collins tells us that only 75,000 barrels were used and 25,000 salted. Is that the kind of cheap food production that you wish to preserve at the expense of what I am about to state? There has been a remarkable change of late in the nature of the results of mackerel fishing. Several years ago, when 300 barrels of mackerel were caught, 200 of them were No. 1, fat, valuable fish; 66⅔ per cent of the whole were fit subjects for consumption by human beings.

What are the actual results now, as taken from the books of Lewis Chase and Whitten, of Portland, for the year 1884? Of 14,877 barrels taken, 317 barrels were No. 1; that is, less than 2.2 per cent, instead of 66⅔ per cent. Of No. 2's there were 3,121 barrels—less than 21 per cent; and the balance, 11,439 barrels, were of poor quality—No. 3's, or perhaps worse. The result of all this is that under this system of fishing the proportion of No. 1 mackerel has been reduced from 66⅔ per cent of the whole to less than 2.2 per cent, and the number of No. 3's has increased to 75 per cent. Now, what is the effect of that upon the production of this food for the people? Most men know nothing of these details. To most men a mackerel is a mackerel, and there's an end of it. When they go to buy a mackerel if they get one they do not like they do not go any more. You see there is a temptation to dealers all the time to brand up their goods, because, I am sorry to say, the dealers in fish are no more honest than the members of the legal profession—things are branded up.

Mr. LORE. If the gentleman will permit me, I wish to ask him whether this change does not grow out of the change in the manner of catching the fish, the change from the line to the purse net.

Mr. REED, of Maine. I have no doubt of it, and the result is that the great majority of these fish are taken during the spawning season, when they are very poor. I can show from the report of Mr. Collins (whom I am going to quote as an expert against these other gentlemen) that all these fish are good after the spawning season.

To resume what I was saying, the effect of stopping the catching of the fish at the season when they are bad and really not suitable for food will be that we shall have good fish caught and good fish distributed all over the United States. There will be an increased market for them and an increased supply, because the catch of good, sound mackerel will be largely increased. So, then, I urge this bill, not only on behalf of my constituents, but on behalf of all the people of the United States.

Gentlemen may ask, "What people are you keeping out?" and among the cries raised in opposition to this bill is this: "You want to wait until these fish get up along the coast of Maine so that

your people can catch them all. The fish proceed northward, and you want to shut us out until after the 1st of June, when they will have gone up north, so that you can catch the whole of them." Well, I trust I have been in this House long enough not to attempt a steal of that kind. [Laughter.] What is the fact? Why, the fact is that of the one hundred and eighty-four vessels that are engaged in the spring mackerel fishery, which we want closed, not a solitary vessel can be found outside of Maine and Massachusetts. So we have got the whole business now. But the truth about it is that, as Captain Collins says here in this report, when the fish get well filled with spawn in June they dive down in order to accomplish the work. Then there is another difficulty. When the fish start in the warm waters about the Gulf Stream, at the beginning they are huddled together, and this pursuing them with purse nets breaks them up and drives them way offshore, scattering as well as destroying them.

Why, look at it. In the face of scientific authorities, I will not undertake to say we can prove that the destructive agency of man will extirpate the whole mackerel tribe from the face of the earth; but I will say this, every man on the New England coast knows that the lobster has almost disappeared. You can now only catch lobsters about 10 or 12 inches long, and I can remember when the ordinary size of the lobsters caught was nearly twice that length; and according to Mr. Evarts there are affidavits in existence as to lobsters weighing 25 pounds, although I believe the lobster of that weight was not producible at the time the affidavit was made. [Laughter.] We know that the supply of halibut is thinned out, and that the case is the same in regard to a great many other kinds of fish. I am aware that Professor Huxley says there is no proof that the herring has been diminished by the agency of man. But while I can not absolutely prove the necessity, I say all these considerations put together render it exceedingly desirable that this experiment should be tried.

I hold in my hand the printed statement of a gentleman who is probably as conversant with this subject as any other man. He came to the committee with the emphatic recommendation of Professor Baird, who has employed him specially with regard to this part of the fishery question; and whatever information Professor Baird may have has been derived largely from this gentleman, who says there is no doubt that there would be a great improvement in the quality of the fish if we should adopt this measure; and then he comments upon the question of cheap food very much as I have done.

One other consideration. Why is it that our people, having complete possession of this fishery, wish it to be closed as proposed in this bill? I have given you some of the reasons; and I will give you another. It is at present a fishery of so poor a character that it does not pay; yet nevertheless we are forced into it, and why? From the same peculiarity of human nature that sustains the Louisiana Lottery. Out of one hundred and eighty-four vessels engaged in this fishery three or four make large hauls and find the business profitable; the others expect that they may do the same; and if one goes into it all go into it. Now, all should be stopped.

I think I have stated reasons why this bill should be passed. Let me recapitulate them. The bill is a trial proposition for five years. It is a proposition to close this fishery during the spawning season, from March until the 1st of June. Its purpose is to increase the character and value of the fish which will be distributed to the people of the United States. If I have made these points as clear to the House as they stand in my own mind I can not doubt the result. Allow me to add that this is a matter of serious import to my people. They are deeply concerned in this question; and I know of no opposition to this measure that has not its origin in the fishmongers' association of one place or another. We propose to stop the catching of these fish during the period named by stopping the importation and sale; and the United States being the only place where they can be sold, if we stop their sale here the fish will not be caught.

There is another class of fishermen represented by my friend from New Jersey [Mr. Buchanan], a class with which I confess I have sympathy; and I hope, when I perfectly understand his amendment, to be able to assent to it; if not, I shall have to submit to the vote of the House on that question. He states that the people on the New Jersey coast are interested in fishing carried on in rowboats; and that this measure, without the amendment he suggests, will cut them off from some degree of sustenance during the period to which the prohibition will apply. I sympathize with the gentleman's position, for the consideration he presents is of similar character to that I present in behalf of my people. It may be, however, that we can not arrange a close season without injuring somebody. But I trust I have shown the counterbalancing advantages to be so great that this House will not hesitate to give the fishermen of this country what they all demand.

Mr. HEWITT. Mr. Speaker, I suppose the House would like to know how it happens that a bill of this importance comes before the House with a report in its favor and no minority report, and yet a member of the Committee on Ways and Means takes the floor in opposition to the bill. The reason

is that the bill was ordered to be reported in total ignorance of the facts of this particular fishery. I take it my friend from Arkansas [Mr. Breckinridge], who made the report, will admit that if all the facts now known had been presented to the committee and discussed in committee, as they were not, there would have been at least a very considerable difference of opinion as to the propriety of this measure.

Mr. BRECKINRIDGE, of Arkansas. I hope the gentleman from New York will not attempt to express what other gentlemen think. I have expressed no such opinion as that, and I assent to no such opinion. If other gentlemen of the committee agree with my friend from New York I hope they will so announce, but until they have done so I trust he will not claim them as concurring with him.

Mr. HEWITT. I have claimed nobody. I only repeat what I said: That there was no discussion in the committee which could possibly have led to the presentation of any minority report. The facts I am about to bring to the attention of the House were offered to the attention of the committee, but it was after the bill and report had been submitted to the House and were placed upon the Calendar.

Mr. BRECKINRIDGE, of Arkansas. The gentleman from New York is aware the committee is well able to take care of itself. If the gentleman has a great deal of information he deserves credit for it, but I do not think he is the sole gatherer of information, or that other gentlemen are as ignorant as he seeks to represent them.

Mr. HEWITT. Before I am through with the matter it will be discovered when and why at the time the report was made.

Mr. Speaker, if this bill should be enacted into a law it will certainly produce three results:

First, it will deprive a large number of the people of this country of a cheap and nutritious food.

Secondly, it will deprive of employment a very large number of fishermen, more than two thousand in number, who find occupation in this business between the months of April and June in mackerel catching, which it is now proposed to prohibit.

And, lastly, it will confine the mackerel fishing to the States of Massachusetts and Maine, because mackerel arrive on this coast about the end of March. They come chiefly off the mouth of Chesapeake Bay, and proceed thence slowly northward and reach Massachusetts and Maine in the month of June, when this bill, if enacted, would cease to operate. While fishermen along the coast below were prohibited from fishing, the whole mackerel schools, whatever they amount to, would be open for the fishermen of the States of Maine and Massachusetts.

Now, as to the quantity of this food. There are about one hundred and eighty vessels which are engaged in catching mackerel from the 1st of April to the 1st of June. The quantity caught is somewhat fabulous.

The gentleman from Maine [Mr. Reed] referred to the testimony of Mr. Blackford, that on one occasion last year 15,000,000 of mackerel were brought into the city of New York, and the inability to handle them—of the market to take them—was so great they were finally given away by basketfuls to the poor. This year the mackerel have been somewhat late in coming on the coast, probably due to the cold weather. I happened to see the first vessel which came into Fulton Market. It contained 30,000 mackerel. Two weeks later, in a single day, 8,000,000 of mackerel were brought into the port of New York and distributed, not as the gentleman from Maine said, in the immediate vicinity of that port, but under the modern system of refrigerating cars were sent over the entire United States.

The fact is, transportation has come in to distribute this food to every point east of the Rocky Mountains, making this a question of importance to the whole country. This prolific catch of mackerel has gone on so that last night I received from Mr. Blackford, who, perhaps, is the best practical expert in matters of fish in this country, this telegram:

> Since last Monday [that is, four days] four thousand five hundred and ten barrels of fresh mackerel landed and sold in Fulton Market; all large, fine fish.

I quote that now as an answer to the assertion of the gentleman from Maine that this spring's fishing produced only fish of an inferior grade.

There is authority for saying many of these fish are not good for salting. That is true. Spring mackerel are not so good an article for food as those caught later in the season; but for fresh food, which in the spring of the year every man, whether he be workman, lawyer, or statesman, craves, mackerel is one of the best food-fishes which is put upon the table.

Now, a proposition to destroy an industry employing over two thousand of these very fishermen for whom the gentleman from Maine seems to be so interested, and they are his people—by whose aid this fishing is done in the main—a proposition to take away from them an employment which is so advantageous to them and so useful to the whole community ought to rest on very clear authority.

That it is a damage to the mackerel fishing is beyond question. My friend from Arkansas [Mr. Breckinridge], when interrupted yesterday as to whether he had consulted the Fish Commission on this subject, replied, as stated in the Record, that he had been talked with, but had not been consulted by the Commission.

My friend's memory must have been rather short on that occasion, for I hold in my hand a letter addressed to him from Professor Baird——

Mr. BRECKINRIDGE, of Arkansas. If the gentleman will read my remarks in the Record he will find that they are entirely in harmony with the statement that I had made no specific inquiry as to the pending bill. I refer the gentleman to the Record.

Mr. HEWITT. I understand what the gentleman said; it appears in the Record; and if you will give me the Record I will quote the exact language so that there can be no question as to the accuracy of it.

I hold in my hand a letter addressed to the gentleman from Arkansas as a member of the Committee on Ways and Means, signed by Spencer F. Baird, Commissioner, being an official answer to the inquiry addressed to him; but first I read from the Record the remarks of the gentleman in answer to the inquiry as to whether the Fish Commission had been consulted with reference to this bill or not:

> Mr. LORE. Let me ask the gentleman from Arkansas whether the Fish Commission of the United States have favored this bill?
>
> Mr. BRECKINRIDGE, of Arkansas. I will state in response to the gentleman from Delaware that the Fish Commission of the United States has not been asked specifically about the bill; though I have talked fully with the Commissioner and others of the service, and had some correspondence with them about the propositions involved; and I have here in my hand a very interesting letter from the specialist employed by Professor Baird to study and observe the habits, etc., of the mackerel, Captain Collins, a gentleman whom I am assured by Professor Baird is the best living authority on the subject, and his statements of facts strongly sustain this bill.

In which it will be seen that the gentleman has omitted altogether every reference to the letter of Professor Baird himself. Now I will read to the House that letter, and I suppose it will not be questioned that Professor Baird is recognized throughout not only the whole of this country but the habitable globe as second only to one man whose authority I shall also produce, Professor Huxley, in regard to the effect of fishing in any form or shape upon the catch of deep-sea fish. He says:

> UNITED STATES COMMISSION OF FISH AND FISHERIES,
> *Washington, D. C., February 15, 1886.*
>
> DEAR SIR: I have received your letter asking for an opinion as to whether "the preventing of mackerel fishing during the spring months is necessary for the maintenance of an abundant supply of that fish upon our shores."
>
> I have never been convinced that the abundance of mackerel has been in any way affected through the agency of man. The catch in 1884 and 1885 was far above the average for the past fifty years. It is not impossible, however, that the continuance of the use of the great purse-seines may in time have an appreciable effect in decreasing their numbers. The statistics of the next few years will doubtless enable us to form a definite opinion upon this question.
>
> Naturalists are obliged to admit their ignorance in regard to many portions of the life-history of the mackerel and other fishes of similar roving habits. We do not yet know definitely where they go in winter, nor by what routes they approach our shores in spring. We are equally ignorant of their habits during the breeding season. So important has the study of these matters been considered that I asked some years ago for a schooner especially adapted for their investigation. Congress at its last session acceded to this request, and the vessel has been built and is now nearly ready for service. I hope that in the near future the habits of the mackerel, the menhaden, and the bluefish will be as thoroughly understood as are now those of the trout and the cod.
>
> The bill before you would appear to aim at the prohibition of mackerel fishing prior to and during the spawning season. In reality, however, the time of spawning, especially on the coast of New England, extends considerably beyond the 1st of June.

So that the bill would not effect the object, for the only spawning of value which takes place is in and after the months of June and July.

> The probable effect of the passage of this bill upon the extensive pound and weir fisheries of southern New England is worthy of your consideration, since the pound fishermen can not exclude mackerel when they admit the other species which are swimming in company with them.

So that if this were adopted the pound fishing would have to be stopped; and I leave that to my Massachusetts friends to determine its value.

> In conclusion, I regret to say that in the present state of knowledge of the life-history of the mackerel I am unable to express a positive opinion as to whether or not the passage of the bill under consideration would have a beneficial effect.
>
> Very respectfully,
>
> SPENCER F. BAIRD, *Commissioner.*
>
> Hon. C. R. BRECKINRIDGE,
> *Committee of Ways and Means, House of Representatives.*

Now, Mr. Speaker, there is the judgment of a thoroughly disinterested man in the presence of a proposition to deprive the people of this country of an almost unlimited supply of food for a period of three months, and a great number of fishermen who are entitled, as the gentlemen from Maine has well said, to great consideration at the hands of this House in view of their difficulties with Canada; there is his opinion that this bill could not be said to have any beneficent effect whatever, that he does not know and is not able to state what the effect would be. That is the opinion expressed here.

Now he has an assistant, Professor Brown Goode, who was sent out in charge of the American exhibits to the London Fisheries Exposition and received a medal. I presume it will scarcely be questioned that Professor Goode and Professor Baird are two among the greatest experts of the world in this line. I wrote him a letter myself later upon this subject, for I was ignorant of the effect of it, and asked his opinion. In his response he says:

UNITED STATES NATIONAL MUSEUM, *Washington, April 12, 1886.*

DEAR SIR: I have never been convinced that the abundance of mackerel along our eastern coast has been, in past years, diminished through the agency of man. I am not, therefore, prepared to say that I believe that the prosecution of the spring mackerel fishery will lead to its own destruction. In a report upon the history of the mackerel, published in 1883 by the Commissioner of Fisheries, I reviewed the evidence at that time in existence, and I have not yet seen any reason for changing the views therein expressed. I mail you herewith a copy of this report.

Believe me, yours, very respectfully,

G. BROWN GOODE.

Hon. ABRAM S. HEWITT.

In this report, which I have here on my desk, giving the facts and conclusions which are the results of careful research, discussing as it does all of the phases of the mackerel question, and in this public document, which is at the disposal of any gentleman, all of these facts will be found fully set forth and sustained.

Now, the gentleman from Maine says it is necessary to have a close period for mackerel. That is what he wants. That is a very plausible idea, Mr. Speaker, and I was originally taken in by it myself. Every man who has ever approached the subject has thought that there ought to be a close period for animals to breed in. But when you examine the facts you will find that there are two classes of ocean fishes. Those which come into our rivers and seek the fresh water for spawning purposes need a close period, because if all were taken, as the salmon have been taken at the mouth of the river when running in to spawn, there could never be a return current of young fishes after the spawning season.

Hence we have wisely provided for close periods for the ocean fishes that seek the fresh water to spawn. But there is another class of ocean fishes, such as mackerel, herring, the cod, the bluefish, and the menhaden, that never spawn in fresh water, that never come to the rivers or coast to spawn. And in regard to the mackerel there is this remarkable fact: They spawn upon the surface, upon the open ocean, upon the broad surface of the ocean. Their spawn is at the mercy of the winds and the waves; no doubt wisely so. No doubt in the order of Providence that is the method which He has taken for the production of certain kinds of fish which the energy of man has never yet been able to destroy. The herring fisheries of to-day are more productive than they have ever been in any previous period of man's history since we have had any record. The mackerel fishery of to-day is more productive than it ever has been in any previous period. When you remember the spawn of a single mackerel produces 500,000 eggs you will understand how small a quantity is necessary to produce the number of mackerel we take in a single season; it is safe to say less than 500,000 mackerel would produce the entire catch of 25,000,000 of mackerel supposed to be taken in a single season.

So you see that man can not, by any contrivance whatever, destroy these fish which come in large schools. Do gentlemen here know the magnitude and size of these schools which are sent upon our coasts for the express purpose of giving us cheap food? One fisherman I saw told me he had met this year a school of mackerel 7 miles long and 2 miles broad, and packed so densely that it seemed to him as if the water could find no place among them; and yet this is the kind of animal life which the gentleman from Arkansas and the gentleman from Maine say is worried by the attempts of the fishermen to catch a few of them, and is driven off the coast in consequence of it. There is no possibility of worrying them. When taken by one of these purse-net seines, they are scooped in, as many as the net can hold, put on the vessel, and brought into port, and the rest go no one knows where. Even the gentleman from Maine [Mr. Reed] admits that when they spawn on his coast, the mackerel disappear for a time. He did not tell us whether they disappeared before or after they spawn. But the mackerel disappear. Where have they gone? Into Fulton Market?

Mr. REED, of Maine. As the gentleman from New York is quoting me, I will read the exact language I quoted from someone else:

> At this time in June the fish appear to sink out of sight for two or three weeks; this occurring a few seasons a little earlier or later than at other times, owing probably to the varying temperature of the water. It is said they have gone down to spawn.

That is the testimony of Captain Collins.

Mr. HEWITT. I thank the gentleman for giving that testimony. Captain Collins is a great expert, but he does not know what they go down for; nor do I, nor does the gentleman from Maine. I do not know what they go down for; but this is certain, notwithstanding the fact that this work of destruction has been going on for the last fifteen years when the purse-seine contrivance was first adopted, and for ten years and with the same energy that it is now prosecuted and with the same results, the catch of mackerel has gone on, with slight variations, steadily increasing. It is true that we do not get the same quantity of No. 1 mackerel that we formerly caught, but those statistics are the statistics when the mackerel were caught by the hook and line; and that was the point of my question to the gentleman from New Jersey, whether when his Jersey constituents go out to catch mackerel with hook and line, they do not get as good fish as ever.

And that reminds me that all this talk about taking mackerel in the spawning season is simply ridiculous in view of the facts. In the first place, it turns out as a curious fact in natural history that three-fourths of the fish caught in the spring fishing are male fish, and only one-fourth are female fish. Will some one undertake to explain by what provision of Divine Providence the female fish are preserved out of sight, not within the range of these nets, while the male fish are principally taken? And let me mention another thing as to the shad. A shad is not regarded as fit to eat except when it is in the spawning season, and what is true of the shad is true of the mackerel. The mackerel that have been brought in to New York this year, as certified by Mr. Blackford, turn out to be a very large, better, and a finer class of fish than have come there for the last few years. If I, like the gentleman from Maine, were to reason *post hoc propter hoc,* I would say the seine-fishing is steadily increasing and improving the value of the fish; they get better all the time, every year a little better than they were the year before. But I confess frankly I do not know anything about it. I only know the fact that we get mackerel, that we get them in increasing quantity, and that they are a fish essential to the support not merely of my people, but of the people whom all of you represent on this floor. Now this testimony which I have cited agrees with the testimony of everybody who has carefully considered this subject.

Mr. Blackford is one of the fish commissioners of the State of New York, and is also the assistant fish commissioner of the United States in charge of the oyster beds. He is a fish-dealer, a most remarkable fish-dealer, an honor to his State and to his country, a man who devotes the profit of his great business (and he is the greatest fish-dealer in the world) to the propagation of food-fishes and the investigation of the laws which govern their growth and their perpetuity. Mr. Blackford testified on the subject before the Senate committee, and in his testimony he said that he had begun (as all of us have begun) with the idea that the mackerel fishery and all the ocean fisheries would be injured unless provision was made for a close season. He says:

> Not being much of a writer or speaker, it was a matter of considerable labor for me, and I went to work to get together my facts from my own diaries that I keep of the daily supplies of the markets, and of the prices and notes that I take of the large catches, in order to prepare this paper to be read; but when I got my material all together, I found the facts were entirely opposite to the views which I had entertained, and the more I looked into the subject the more I became impressed that there was no necessity for legislation for the protection of any of the free-swimming open-sea fishes.

There is the conclusion of the most intelligent practical man on this subject in this country, who went into the investigation with his mind made up that protection was necessary in order to preserve these fisheries from damage, but who came out of it satisfied that his former view was wrong, and testified before the Senate committee that in his judgment it was impossible for man to do any injury to the ocean fisheries.

This same question has been up time and again in Great Britain. It has been the subject of royal commissions. The last commission that sat upon it was headed by Professor Huxley. I hold in my hand a paper by that eminent scientific man in which he sums up the matter, and which is so interesting that I shall read it at a greater length than I otherwise would. It was published in the Popular Science Monthly for August, 1881. In this paper Professor Huxley is speaking of the herring; but the habits of the herring and of the mackerel are almost identical. There is, however, a slight difference in their mode of spawning.

Professor Huxley says:

Suppose that every mature female herring lays 10,000 eggs, that the fish are not interfered with by man, and that their numbers remain approximately the same year after year, it follows that 9,998 of the progeny of every female must be destroyed before they reach maturity. For, if more than two out of the 10,000 escape destruction, the number of herrings will be proportionately increased. Or, in other words, if the average strength of the shoals which visit a given locality is to remain the same year by year, many thousand times the number contained in those shoals must be annually destroyed. And how this enormous amount of destruction is effected will be obvious to any one who considers the operations of the fin-whales, the porpoises, the gannets, the gulls, the codfish, and the dogfish, which accompany the shoals and perennially feast upon them; to say nothing of the flatfish, which prey upon the newly deposited spawn, or of the mackerel, and the innumerable smaller enemies which devour the fry in all stages of their development. It is no uncommon thing to find five or six—nay, even ten or twelve—herrings in the stomach of a codfish, and in 1863 we calculated that the whole take of the great Scotch herring fisheries is less than the number of herrings which would in all probability have been consumed by the codfish captured in the same waters if they had been left in the sea.

Man, in fact, is but one of a vast cooperative society of herring-catchers, and the larger the share he takes, the less there is for the rest of the company. If man took none, the other shareholders would have a larger dividend, and would thrive and multiply in proportion; but it would come to pretty much the same thing to the herrings.

And the fact is the same in regard to the mackerel. Finally, Professor Huxley says in conclusion:

I do not think that any one who looks carefully into the subject will arrive at any other conclusion than that reached by my colleagues and myself; namely, that the best thing for governments to do in relation to the herring fisheries is to let them alone, except in so far as the police of the sea is concerned. With this proviso, let people fish how they like, as they like, and when they like. At present I must repeat the conviction we expressed so many years ago, that there is not a particle of evidence that anything man does has an appreciable influence on the stock of herrings. It will be time to meddle when any satisfactory evidence that mischief is being done is produced.

Now, I think I have shown that there is a "plentiful lack" of knowledge on this subject; and in the presence of this lack of knowledge we are asked to pass a bill which it is admitted, if passed now, is too late to have any effect this year, either good or bad. We are asked to pass now a measure which can not take effect until next year, though by referring the whole subject to the Fish Commission we can get their deliberate opinion in time for action in December next. That is the wise and sensible thing to do. I think the Fish Commission will probably know something more on this question than they do now, but I do not expect they will ever get any knowledge which will serve to show that the fisheries can by any possibility be affected by any quantity of fish that man, with all his contrivances, can take out of the ocean in any period of two or three months; for after all this fishing is over, these vast schools of mackerel are found passing up the coasts of Massachusetts and Maine to Canada; so all that we do not take go to Canada for her protected fishermen because our people, as the law now stands, can not go there and take any of those fish. If then this bill passes, it will have but one effect. It will entirely prevent mackerel fishing below the coast of Massachusetts; it will confine it for a brief period to Massachusetts and Maine; and these fish will then pass to Canada, out of the reach of our fishermen.

In the face of these facts, which can not be controverted, the gentleman from Maine says, "If you will pass this bill, we shall be able to supply you with big mackerel." That is not what my constituents or the people of this country want, for the big mackerel fetch a big price per pound. Twenty-five cents per pound is often charged for large mackerel, while little mackerel sell for 1 cent a pound. The only effect of the bill advocated by the gentleman from Maine will be to take away mackerel as the cheap food of the common people and give it as a luxury to the tables of the rich.

Mr. Speaker, the catch of mackerel in one year, according to the figures cited by the gentleman from Maine, was about 14,000 barrels, of which 66 per cent, he said, were large mackerel, which would be 8,000 or 9,000 barrels. Sir, in four days in the city of New York half that number—4,500 barrels—were sold and distributed as cheap food to our people. So that if you pass this bill you merely prevent a great industry from being carried on in order that you may have a few barrels of very fine fish.

The gentleman also said that all the fishermen are in favor of this measure. Well, sir, I went upon a fishing boat, the captain being a Gloucester man, having a crew of eight fishermen. When I asked him whether he wanted this fishery stopped he said he did not; that it gave them employment at a time when they had no other. "But," said he, "we will settle this business." So he sent me down a series of petitions, which are signed by these rude fishermen.

These petitioners say:

The undersigned, mackerel fishermen, being aggrieved at the introduction in the House of Representatives of the bill (H. R. 3538) entitled "A bill relating to the importing and landing of mackerel caught during the spawning season," and whereby the catching and landing of mackerel from March to June 1, inclusive, are prohibited, hereby protest against the same.

First. It is an experimental and unnecessary bill.

Second. During the months mentioned very few mackerel spawn.

Now, these fishermen know something about this matter.

June and July are the principal spawning months.

Third. Mackerel are increasing and not diminishing in quantity.

Fourth. The passage of the bill would turn out of employment during the prohibited season over two thousand of our fishermen, who are dependent thereon for the support of themselves and their families.

And we earnestly ask that the passage of the said bill be defeated.

Now, this petition is a genuine article—not the kind made to order. Here are the signatures of hard-working, honest, diligent fishermen, who only ask to be let alone, to be undisturbed in the pursuit of an honest livelihood. They are the gentleman's constituents, not mine, for whom I appeal to this House. They sell to my constituents what my constituents want to buy; but they want to be let alone in their honest industry. Yet, in ignorance of the facts of the case, and in the presence of the scientific testimony, so far as it goes, that no good can come from this measure, this House is asked to pass it when there is every reason why, out of regard to the food of the poor, the occupations of the industrious, and the general good of the whole country, we should not only go slowly, but if necessary vote the measure down. I have no desire to subject these gentlemen of the committee to the humiliation of having the enacting clause of this bill struck out. I prefer that it shall be recommitted. I want them to study this subject a little more thoroughly than they have studied it, although they seem to be satisfied with the knowledge they have thus far obtained. I am not satisfied with what I have been able to get within this short time; but I say, so far as the facts appear, there is abundant reason to apprehend that this proposed legislation is not only unnecessary, but dangerous and destructive to interests which are entitled to the consideration of the House.

Mr. HAMMOND. This seems to be the application of game laws to food-fishes. I wish to ask the gentleman whether such a thing has ever been done before by the United States.

Mr. HEWITT. There has never been any such measure as to open-sea fishery. There has been the application of the close season to those fishes that seek the fresh waters to spawn; and even there the Government of the United States has had to keep its hands off, because the State jurisdiction in almost every case comes in. The Fish Commission has sought for the cooperation of the States wherever it could be obtained, and has in most cases been able to get it.

Mr. REAGAN. As the attention of the gentleman from New York has been directed to this question, I wish to inquire whether the Government of the United States has ever heretofore undertaken to regulate fishing upon the high seas outside of the marine league, and whether Congress has authority to regulate fisheries on the borders of States within the marine league.

Mr. HEWITT. I have not given my personal attention to that matter. It is a legal question; and such questions I always prefer not to discuss. But I think in this House, so largely composed of lawyers, that question can be readily answered. I know of no power on the part of the United States to control fishing within the jurisdiction suggested by the gentleman; but I do recognize the fact that in licensing fishing boats, the Government of the United States might put in the licenses a provision limiting the operations of such boats. I suppose that might be done.

Mr. MCADOO. As the gentleman from New York has given this subject some investigation, I will ask him whether it is not the fact that the menhaden fishing is doing more harm than any other class of fishing on our coast?

Mr. BUTTERWORTH. I understand the point in this case to be that the supposed danger against which this bill is directed does not exist.

Mr. HEWITT. It does not exist according to the testimony of every intelligent man who has examined the subject.

Mr. MILLIKEN. Mr. Chairman, I desire to say, if the gentleman from New York [Mr. Hewitt] has at last got through, that I do not purpose to discuss the constitutional objection which is raised against this measure, as it is raised against every measure which is called up for consideration in this House and which certain gentlemen wish to defeat. Indeed, I do not purpose to discuss the question at length in any of its aspects; but it seems to me to be a question whether we will legislate to save the source of supply of a valuable article of food, the source of a great industry, or allow people for immediate gain to kill the goose that lays the golden egg.

And in this controversy the same old question arises, and it arises between the same parties as when I first heard it discussed; that is, between the fishermen and the fishmongers. I know how it was in my own State. We had all these arguments against the protection of the menhaden. They told us menhaden could never be lessened on the coast of Maine by the hand of man. I have gone down to the shore and have seen at one time thirteen steamers fishing for menhaden, a single steamer taking 800 barrels of these fish at one haul.

Our people wanted menhaden protected by law from this wholesale slaughter in order that our fishermen might have them to use for bait in catching cod and other large fish. And by the way, sir, if this had been done sufficiently early the trouble between us and Canada would never have occurred, because we would have had an abundance of bait upon our own coast to supply all our fishermen.

When, however, it was proposed to protect the menhaden by legislation the same reasons and excuses were urged against it that we have listened to to-day. The fishmongers and the great corporations interested in the product of these fisheries defeated for a time the efforts made for the preservation of the menhaden. At last these fish left our shores, and during the last eight or nine years there has not been enough menhaden caught on the coast of Maine to supply bait for our fishermen.

The gentleman from New York [Mr. Hewitt] says that out of ten thousand eggs deposited by the female fish not more than two escape destruction before the young fish are hatched, and he by allowing the fish to be taken in spawning time would destroy these two. My colleague has referred to the effort made in Maine to protect by legislation the lobster from annihilation. These efforts finally succeeded in procuring the enactment of a law providing for a close time, and that lobsters less than a certain length should not be exposed for sale.

But this law, while it has arrested the destruction, and I hope may prevent the extermination, of the lobster, came too late to save it from being so seriously diminished, both in numbers and size, that this fish once so plentiful and cheap is now comparatively rare and dear, and will average less than one-half its size of twenty years ago. Still, we had the same experience in obtaining legislation to preserve the lobster that we had in trying to save the menhaden, the same we have here to-day in our efforts to prevent the extermination of the mackerel. Our opponents quoted from scientific gentlemen, produced the testimony of theoretical experts, and talked of the enormous number of eggs which the fish deposited, but what the practical fisherman said proved to be correct and what they petitioned for was shown, as I am sure it will be in this case, to be wise.

My friend from New York says we are selfish in this thing; that we want this bill to pass so these fish will be caught on the coasts of Maine and Massachusetts. He, however, recognizes the fact that they are all Maine and Massachusetts fishermen who catch these mackerel. What does it matter to him whether they catch them in one part of the ocean or another? Does he think they are any better caught off the coast of New York than when they are caught off the coasts of Maine and Massachusetts?

What has been said in favor of the bill I know to be true by experience, because I have seen mackerel caught ever since my boyhood.

If mackerel are caught before the 1st day of June and put on the market for sale, very few people who know what good wholesome mackerel are will want them. Why? Because they are then a poor article of food. Indeed this involves the question of good or poor food for the people. Mackerel when spawning time is over, and they have had an opportunity to fatten, are, as the gentleman has said, the finest fish in the world. But before that time, when caught off the coast here, I am bound to say from experience they are the meanest fish that swim—too mean to be eaten by anybody, rich or poor.

Now, Mr. Speaker, I did not intend, as I said when I rose, to make any lengthy remarks upon this subject, but I do not see why the people of this country are not as much interested in having a close time for fishing for mackerel as they are in having the fisheries protected in our several States by legal enactment. I do not see why the people of the whole country who consume fish, as well as the fishermen themselves on the coast who earn their livelihood by fishing, should not be as much interested in the protection of this great article of food and this important industry as they are in the protection of game, which in many of our States is so zealously guarded.

We are everywhere establishing fish-breeding places in order to cultivate the supply of food-fishes, and I am glad to be able to say that the salmon on the coast of Maine, which had been growing scarce, have sensibly increased since fish-breeding was established at Bucksport. And while we are taking so much pains to propagate our valuable fishes, does not a wise economy demand that we should prevent as far as possible their wanton destruction?

Mr. BUTTERWORTH. I wish to ask the gentleman from Maine, with his permission, a question in connection with one remark of the gentleman from New York. He says the testimony of gentlemen who are interested in the success of this industry points to the fact that the spawning season is early in June and July, and not largely in March and April. What are the facts and what is the testimony which the gentleman has on that particular point?

Mr. MILLIKEN. Mr. Speaker, I desire to say, in answer to my friend from Ohio, that if I should attempt to reply to the immense amount of misinformation which the gentleman from New York has this morning given to the House on the subject of fish and fisheries of different kinds, I think I would

require much more time than I would care to consume in this House and much more I am sure than anybody would like to occupy in listening to me. But the testimony to the contrary of the statement of the gentleman from New York is abundant and overwhelming.

The gentleman from New York has quoted Professor Baird and others, and what does it all amount to? When he gets through, it amounts to the fact that he admits that he knows nothing about the habits of these fish, and notwithstanding this he has talked to the House almost an hour, and has succeeded in giving us such lack of information as we should have a right to expect from one making such an admission.

Sir, I say in conclusion that the question is whether we shall allow men for immediate gains—men who do not regard the future of this great industry, nor the necessities of our people so largely benefited by this article of food—to impair its supply, as has been done in the case of the menhaden and lobster, or shall we, by administering a timely and effective remedy, preserve it?

The importance of both cheap and wholesome food for the people demands that the mackerel, which is almost universally used, should be allowed to perpetuate itself and should be taken only when in good condition, and I believe that the provisions of this bill, designed to secure these objects, will meet with the approval of this House and the country.

Mr. Lore. Mr. Speaker, with all due respect to my friend from Maine, I may be permitted to state that since the days of wooden nutmegs and Waterbury clocks I have not seen such an ingenious piece of mechanism as the construction of this bill. I am not abusing my New England friends, only suggesting a historical fact. I have always admired Yankee ingenuity and skill in devising such mechanism.

But, Mr. Speaker, let us examine this bill section by section and analyze its provisions and effect. This first section provides that no mackerel, other than Spanish mackerel, caught between the 1st day of March and the 1st of June of each year shall be permitted to be imported or landed on our shores. The next section provides that the license to be granted by the United States shall be made to conform to that condition of facts, and shall not authorize the person holding the same to violate the first section.

The third section provides for the forfeiture of the vessel if it violates the provisions of the act, if it be an American vessel, and if not, then it provides for the forfeiture of the mackerel or the fish that are landed.

You will observe that the bill as it stands is an absolute prohibition against catching mackerel from the 1st of March to the 1st of June of each year all along our coast from Cape Hatteras to New England. Let us consider it. This mackerel question is an exceedingly interesting one. The mackerel is in a great degree the most mysterious fish in its habits and haunts. They first approach our shores in March off Cape Hatteras in North Carolina in immense shoals, and pass northward until they strike the coast of Maine, which they reach about the month of June. Now, I am not responsible for the truth of what a very intelligent gentleman said last night, but will give it in passing. He said that the ingenuity of my friends from Maine and Massachusetts is so great that they secure the kind of food the mackerel are accustomed to, watch their coming, spread it bountifully on the way, toll them all along the coast from Cape Hatteras until they get them up to Maine, and when they get them up there they feed it out in such abundance as to keep them from going farther, to the fishermen of Nova Scotia and Newfoundland.

I presume this is a myth, but is illustrative of the popular opinion of the skill and foolhardiness of our New England friends. But, judging from the mechanism of this bill, it would not strike one as an impossibility.

These fish, as they pass along the coast from Hatteras up to Maine, are caught by the dwellers on the coast in every direction. They are caught by men who go out in boats and bateaus, and as the bill now stands it would prevent a person in North Carolina, Virginia, Maryland, Delaware, New Jersey, or New York from going out in a canoe or a boat and catching and landing fish for his own use.

That I understand they propose to correct by an amendment. If the bill is so amended, that objection would be removed. But there is a broader objection than that. As the bill now stands it would be open and vulnerable to that attack. But if amended, it is vulnerable in other points. But first let me consider the reasons urged for this bill, and which were presented by my friend from Maine, Mr. Reed, in his usually vigorous, terse, and exceedingly forcible style. The first one is that it benefits the fisherman. Now I say to the gentleman in all frankness that there are other fishermen than those on the coasts of Maine and Massachusetts. The mackerel run from Hatteras up to Maine. They get up to the coasts of Massachusetts and Maine in June; so if you prevent the catching of mackerel up to

the 1st day of June all dwellers on the coast up to Massachusetts and Maine are prevented from catching mackerel, for this time covers the exact period of their passage from Hatteras to New England.

Mr. REED, of Maine. Will the gentleman allow me?

Mr. LORE. Yes, sir.

Mr. REED, of Maine. There are none that go out to catch these schools of mackerel. There are only fishermen that go out within 10 miles of the shore, and those we propose to provide for. The only ones that are interfered with by this bill after the amendment is made are people from Maine and Massachusetts.

Mr. LORE. Then this is an attempt to prevent your Maine and Massachusetts men from taking the fish at that time?

Mr. REED, of Maine. It is an attempt to stop that kind of fishery during the spawning season.

Mr. LORE. I do not know that that alters very materially the point I make as to whether or not the bill benefits the fisherman. If the amendment to the bill corrects the first defect of which I spoke and deprives the Maine and Massachusetts men of the power to catch and bring the fish into New York, it deprives them of just such profits as they may make during that season; and I do not see that it would be a material advantage even to them.

Now take the other ground, which the gentleman from Maine presented with considerable force and which strikes me as the one upon which he rests his argument mainly for the passage of this bill: that fishing during these months diminishes the catch; that it diminishes the supply of mackerel.

Let us examine this position? I know my friend from Maine says that the Maine and Massachusetts fishermen, by almost unanimous consent, say as a matter of fact it does. The gentleman from New York [Mr. Hewitt] presented and read petitions of these very men, largely signed, maintaining the opposite view. Congress has at considerable expense established a Fish Commission. The head of that commission is Prof. Spencer F. Baird, who has devoted much of his life to this work. So has Professor Goode, associated with Professor Baird as Assistant Fish Commissioner. Captain Collins, Professor Baird, Professor Goode, Professor Huxley of England, all say that they are not satisfied that the catch of mackerel during this time of the alleged spawning, from the 1st of March to the 1st of June, does diminish the supply. They say they do not know, and in effect that it is not known.

Mr. BOUTELLE. Professor Baird, as I understood the reading of his opinion, states that he is not satisfied the use of the purse seine will not materially diminish the propagation of mackerel.

As I understood the reading, what he said was he was not satisfied that the intervention of man would materially diminish the supply of sea fish. But further on he said he did not feel sure that the use of the purse seine, which is a modern contrivance, might not very materially affect it, and that it might require some years to determine that. So that we have the scientists in doubt about the matter, while the practical fishermen, who have been engaged in this business for years and whose whole avocation depends on the plenteousness of the fish, unanimously, or with practical unanimity, declare the catching by the seine in this close time is materially affecting the supply.

Mr. LORE. I think my friend will agree, and I am sure the reading of Professor Baird's letter will satisfy any member of this House, that he does not believe that the catching of the mackerel during that time does interfere with the supply. Professors Goode and Huxley are quite clear on this point, and the petitions of fishermen presented by the gentleman from New York [Mr. Hewitt] show the fishermen do not agree.

Now, Mr. Chairman, in order to show that the committee itself had evidence before it tending to contradict that proposition, I read from their report where they say:

> That the mackerel continued to abound, and the industry of catching them to increase, is to be accounted for rather by the fact that it is not an anadromous fish, and by reason of the primitive devices of the day, than because of the laws of the period. In 1831 the catch reached its maximum, being 449,950 barrels. It then steadily fell off each year, until in 1838 it was only a little over 138,000 barrels. With varying fortune it fell in 1877 to nearly 127,000 barrels. Each period of decline in the catch, and consequently of comparative exemption from molestation of this fish, has apparently led to the hatching and maturity of sufficient numbers to fully restock our waters. Thus, in 1881 the catch rose again to over 391,000 barrels.

In 1882, 1883, and 1884 the catch has been increasing, and yet during this time not only have the fishermen been catching the mackerel between the 1st of March and the 1st of June, but they have been catching them with the purse net. We have, therefore, right here in the report of the committee, evidence that instead of the amount of the supply decreasing it has actually increased.

Mr. BOUTELLE. Is it not possible that this gentleman mistakes an increased catch for an increased supply? Is an increased catch necessarily an indication of an increased supply of these fish? May not the increased catch be the result of the employment of a larger number of vessels and the use of improved appliances?

Mr. LORE. That may be so, sir, and yet I take it that the number of fish we take out of the sea is the best indication we have of the number of fish in the sea. Certainly it is a better means of gauging the supply than a mere speculation based upon no facts whatever. That the supply of these fish will not be diminished in this way it seems to me has been most clearly demonstrated by the gentleman from New York [Mr. Hewitt].

I remember that a few years ago the old method of catching oysters in Chesapeake Bay by the fishermen of Maryland and Virginia was "tonging." Then the dredge system was introduced, and the fishermen raked the oyster beds from one end of the Chesapeake to the other wherever they could find them. There was a terrific outcry on the part of the tongers that this would destroy the supply; but the result simply was that instead of having oyster beds scattered here and there at special points on the bottom of the bay, the dredges dragged them all over it and made the bottom of Chesapeake Bay almost one continuous oyster bed, and the oysters were multiplied by the thousand. This grew out of the fecundity of the oyster spawn, rivaling to some extent the mackerel in this respect. I know that the analogy between the two cases is not complete at all points, but I mention this to show that the alarm which arises as to the results of new methods is frequently without foundation or any just cause.

Mr. BOUTELLE. Do I understand the gentleman to say that the supply of oysters has not been disadvantageously affected by the use of the dredge? My impression was very decidedly to the contrary.

Mr. LORE. Well, I speak of what I know. I have it from the tongers, as well as from the dredgers, that the effect has simply been to spread the oyster beds over the bottom of the bay and make it almost one continuous oyster bed. As I have said, however, I mention this merely to show that the fears of men in such cases are not always warranted by the facts.

Mr. Chairman, when men speak of the diminution of the fish supply from cause stated it is a mere conjecture. The report of the committee itself shows that the catch, instead of diminishing, has increased; and I say that when it is shown as a matter of fact that more fish have been taken out of the water in a given time it is a fair inference that more have been taken because the supply in the water was larger.

Mr. BOUTELLE. Suppose that the Congress of the United States should address itself to the work of decreasing or rendering extinct the mackerel on our coast (if they should deem that to be a public necessity), can the gentleman conceive of any more efficient manner of starting the experiment than by fitting out a fleet of vessels to use the purse net to take these fish at the spawning season? Is not that exactly what Congress would do if it were going to invest Professor Baird with power to experiment as to the best means of rendering the mackerel extinct?

Mr. LORE. I will answer my friend, although I think he has been already completely answered by the gentleman from New York [Mr. Hewitt]. The answer is this: These fish are preyed upon not only by man, but by a great number of the denizens of the sea, and the share that man takes in their destruction is but as a drop in the ocean; the number that are taken and consumed by man is trifling compared with the multitudes that swarm along our coasts and are consumed in other ways. Therefore, I say you may adopt any device you please, you can not destroy the supply. When you remember that a single female mackerel scatters in the spawning season from 500,000 to 1,000,000 eggs, you can see that the supply must be practically unlimited, and that it will not be seriously affected whatever devices you may employ.

Mr. BOUTELLE. But the gentleman overlooks this fact. When the spawn is thrown out upon the sea and becomes subject to the ravages of those destructive enemies to which the gentleman refers, there is yet a percentage of a chance of its fecundation; but when the fishermen go out with their purse nets and scoop in the fish containing the spawn before it is shed at all, then all possible chance of reproduction from that source is utterly lost.

Mr. LORE. I concede that; but take all you possibly can, the catch is so insignificant in quantity that there is still left enough to people the seas with these fish in inexhaustible supply. No fact has been produced to the contrary. So far as anything is demonstrated in the case, it is that the catch has not decreased; and, as I have said, it is fair to infer from that that the supply is at least as great as it was before.

Mr. BOUTELLE. Fishermen who petition here urge that the quantity has largely decreased; and, as I understand, Professor Baird states distinctly he is not sure this fishing during the spawning season will not have the direct effect of decreasing the supply.

Mr. LORE. Well, he does not know what may occur in the future. But the past and present are our teachers. The gentleman from New York [Mr. Hewitt] has just put in my hands a statement

exhibiting the catch of these fish for the last fifty years; and it shows that there has grown up quite a regular and systematic increase in quantity of catch.

Mr. BOUTELLE. I suggest that if the gentleman from New York will now collect and put alongside of that statistics showing the increase in the amount of beef consumed by the people of the United States, year by year, during the last seventy-five years, it will be equally interesting and equally pertinent.

Mr. REED, of Maine. In other words, it would not show that the mackerel catch has not diminished, as alleged.

Mr. LORE. Let me ask my friend from Maine what evidence he has to-day that the supply of mackerel in the ocean has been diminished at all by the use of these nets—I mean the supply for all practical purposes?

Mr. BOUTELLE. We have the evidence of men engaged in the pursuit of those fish as to the relative difficulty of obtaining a certain quantity. That is the only evidence that can be had.

Mr. LORE. Certainly no evidence of that kind is before the House.

Mr. BOUTELLE. If the fishermen were unable to catch any mackerel at all on the coast, it would not prove there were not mackerel somewhere in the sea, but it would be pretty good evidence to that effect. The difficulty of obtaining the fish is certainly competent evidence to show their increasing scarcity.

Mr. LORE. But, measured by that which is before our eyes, it is fair to assume that the supply is still there, for it not only meets all the demand, but the quantity is so abundant that to-day mackerel are a drug on the market.

Mr. REED, of Maine. How about the quality?

Mr. LORE. I will come to the question of the quality presently. I have been speaking of the quantity; and on that point I think I have said all I care to say. I think I have shown that the quantity is not diminished.

Now as to the quality of the food. I am free to say—and I have no other wish than that all the facts in this case should appear—that not merely from the 1st of March till the 1st of June, but from the 1st of March till the 1st of August, embracing at least the entire month of June and part of July, even while these fish on the shores of Maine and Massachusetts are spawning, the quality is not so good as later in the season, after they become fat; still they are wholesome and palatable food.

I have in my hand a very interesting work upon the fisheries of Massachusetts published in 1833, the author being Dr. Jerome B. C. Smith. In this work the habits of these fish are largely discussed. It has always been a mystery where they came from. Indeed, we might say in biblical language that they are like the wind which "bloweth where it listeth; thou canst not tell whence it cometh and whither it goeth." We know that these fish appear in the northern waters about March and disappear about November. From whence they come to our shores in March, and where they go when they leave the New England coast in November each year, is a profound mystery and a curious study for our scientists. Some say they hibernate in the mud on cold northern shores; others, that they spend the winter under the icebergs in Arctic regions, but in this book one writer states that in the month of November he found immense schools of these mackerel taking their way back apparently to the southern climes. And this writer seems to have satisfied himself and others that these fish passing between the Gulf Stream and the coast go to the deep water south to repursue in another season their migrations northward.

It is urged that the fish caught between the 1st of March and the 1st of August are inferior in quality. I concede that they are not so good as those caught after the spawning season is over; but they are perfectly palatable, wholesome food, though a little poor, that is all. The authorities which have been produced do not show that fish caught during the spawning season are unwholesome food. The very authority cited by the gentleman from Maine, Mr. Collins—who, by the way, was born in Maine—was appointed from Massachusetts; was a mackerel fisherman himself for twenty-five years, and who frankly says he feels an interest in the whole matter, I might say a strong bias in favor of the old calling, and is the only one of the scientists who gives countenance to the theory of the bill. What does he say about these mackerel caught during the spawning season? He does not say that they are unpalatable or unwholesome, but simply that they are of inferior quality. But the point of the matter appears a little later. It conclusively appears that when these fish come into the New York market, though of comparatively poor quality, men living all along the coast buy them with avidity and eat them with gusto. The catching of the fish and the packing of the fish then caught interferes to a great extent with the sale of fish caught and packed on the coast of Maine and

Massachusetts. The reason, then, is clear if you can prevent the catching of mackerel while they are on the coast of the Middle States, and suffer them only to be caught while they can be found on the New England shores, you deplete the market and make a demand for the large stock of mackerel now on the hands of the eastern fishermen and dealers which is now a drug in the market.

I will say, Mr. Speaker, in reference to the quality of these fish, that the fish caught and placed in the New York market during this week have been of the finest quality. I hold in my hand a message from a man who is an expert in the business, who telegraphs from Fulton Market that since last Monday there came into that market 4,510 barrels of fresh mackerel; that that quantity of fresh mackerel was landed in Fulton, and that they were all large, fine fish, readily sold to and eagerly bought by the people seeking fresh fish at this opportune season of the year.

But, sir, I do not put it on that ground only; I have no doubt these fish are somewhat inferior in quality when caught early in the season. I am equally satisfied they are healthy food; cheap and desirable.

I was amazed at what my friend from Maine presented to you. He stated the quantity of No. 1 mackerel compared to the whole catch years ago with the quantity of No. 1 mackerel compared to the whole catch at the present time, and left us to infer this grew out of this spring catch. Did he fairly and frankly give us the true reason for that difference? Did he tell us that the difference was because these large No. 1 fish were caught at that time by hook and line? But the Maine and Massachusetts men were not satisfied with the hook and line; it was too slow; and now they use the purse-net, which has already been graphically described to the House. With that net they surrounded a whole school of fish and scooped them all in, big and little. The difference in quantity was very great because they scooped them in and put them on the market without regard to size.

Mr. BOUTELLE. We want to try and stop Maine and Massachusetts from doing that of which you complain.

Mr. LORE. You can do that in your own State; but you do not propose to do so from June to November while they are on your own shores, but only from March to June while they are on our coast.

The catch may be a little inferior; but let me say to the gentlemen of this House that the man who labors six days in the week, who has house rent to pay, a wife and five or six little ones to feed, can not afford to buy high-price mackerel at 25 cents a pound.

Mr. REED, of Maine. There is where your interesting fishmongers' association comes in, because the man who sells mackerel does not get more than 3 cents a pound, and if the fishmongers put on enough to run it up to 25 cents a pound they are a nice set of people indeed.

Mr. LORE. Suppose this bill should be passed and no mackerel should be allowed to be caught in the months of March and April on the Middle States coast, and that your fisherman in Maine and Massachusetts should only be permitted to catch them after June, what then will be the price to which they will run it up? Will my friend from Maine answer?

Mr. REED, of Maine. We are talking of a time when No. 1 mackerel are not caught.

Mr. LORE. Take away the mackerel coming into New York and Philadelphia from this summer catch cut off by this bill and let your New England fishermen and dealers only supply the mackerel to Philadelphia and New York, and what would be the price of No. 1 then? That is a problem I will leave to my friend from Maine to solve.

Mr. BOUTELLE. We can not when the mackerel are down on the coast of Delaware.

Mr. LORE. Precisely; that is what you should not do. You take good care not to ask to do so while the mackerel are on the coast of Maine and Massachusetts. When gentlemen bring in a bill to prohibit Maine and Massachusetts fishermen from using purse-nets to scoop in whole schools of mackerel, big and little, without regard to size, that will be a different proposition, and it is one for which I hope this House will vote. But there is no such proposition as that before the House. I have considered the question of the quantity and quality of mackerel which have been caught and sold for food. The alleged diminished supply I have already dealt with. The reason for it I have tried to present. Even if the questions were not embarrassed with doubt this House, it seems to me, Mr. Speaker, ought to act with great caution and hesitate to interfere with an industry as large as this is and involving such grave interests. There may be other objections to the passage of this bill, but those which have already been given, to my mind, ought to convince you it should not pass. It seems to me they are unanswerable.

What does the distinguished gentleman from Arkansas [Mr. Breckinridge] himself say as to this? At the very outstart, at the very threshold of this question you are met by the gravest questions as to the right to touch it at all. In the report of the committee they say they are not entirely certain

of their jurisdiction, but as the question was referred to them by the House and the question of jurisdiction seems to be a matter of doubt, they assumed, without arrogating the functions of others, to report the bill. Why, my friend from Arkansas, who has evidently looked into this with some degree of care, doubts, as it must be apparent here, the right of this House, the right of this Congress to pass such a bill.

Mr. BRECKINRIDGE, of Arkansas. The gentleman is mistaken in that.

Mr. LORE. Am I? In what respect?

Mr. BRECKINRIDGE, of Arkansas. I was referring to that as a parliamentary question, not as a legal question. I did not know whether or not it should have been referred to some other committee under the division of labor required by the rules of the House; and it was purely a parliamentary question. The gentleman is going a long way to get at his argument.

Mr. LORE. I beg the gentleman's pardon; I see upon a closer scrutiny of the language of the report that it bears that construction.

Mr. BRECKINRIDGE, of Arkansas. That is exactly the construction it was intended to bear.

Mr. LORE. And you did not consider the question of the right of Congress to deal with the subject?

Mr. BRECKINRIDGE, of Kentucky. We had no doubt of the right of Congress to deal with the subject.

Mr. LORE. Then let me ask the gentleman how far will Congress go beyond the line? I confess, sir, that I have some very grave doubt upon that point. I have some doubt as to whether the right of Congress exists to go beyond three marine leagues, in addition to the questions raised by the gentleman from Texas [Mr. Reagan] who throws grave doubts upon some features of the bill.

I doubt very much the equity and justness and fairness of any bill you may bring in here the object of which is to lay an embargo upon a class of our people occupying three or four or five States, if they see proper to embark in this particular class of busin ss, and that is practically what this bill does. And what is the argument of gentlemen? If it is so profitable, and you pass this bill, then they may not engage in the industry. The Middle States are not now engaged in mackerel fishing to any great extent; but, *non constat*, if it prove profitable, as it seems to be, may they not see proper to equip themselves and go out upon the ocean and engage in the business while the fish are on their coast, in the months from March to June?

Pass this bill, and you throw the entire mackerel catch into the States above the south line of Massachusetts. You lay an absolute prohibition upon all the States south of the southern line of Massachusetts. These are grave questions and ought to be considered in all of their phases. If the vessels are now exclusively owned in Maine and Massachusetts, if this business proves to be so profitable, or even if it be a lottery, men will be found willing to embark in the enterprise, and for five years you absolutely prohibit them from going upon the coast and catching the mackerel and landing them upon our shores. It will prohibit them from catching the mackerel at all; because after the 1st day of June there are no mackerel upon our eastern coast north of Cape Hatteras and south of Massachusetts. They are all north of that point, and you give the whole business to Maine and Massachusetts, a proposition so modest that it strikes one with amazement.

Mr. BOUTELLE. Does the gentleman from Delaware think that there is any reason or expectation that large interests will embark in this business?

Mr. LORE. I see no reason why they should not, or why any people should be excluded. But the main objection to the bill, so far as the small catch is concerned, will be remedied by the amendment which has been suggested.

Mr. BOUTELLE. Can not the constituents of the gentleman from Delaware, if they choose to go into this avocation, come down to Maine and Massachusetts and catch them as our people go from Maine down along your coast to catch them?

Mr. LORE. But that does not answer the objection I make. Of course they can do so; but I see no justice or propriety in saying to the New Jersey or Delaware or New York man who desires to engage in this fishery business that you shall not catch the fish when on your shores, but you must wait until the mackerel have passed by you and gotten up to the coast of Maine before you can be permitted to catch and land them.

Mr. REED, of Maine. But will not any man in Maine or Massachusetts be prohibited as well as your constituents? Is it not a prohibition which prohibits everybody alike?

Mr. LORE. Precisely; but you prohibit our people while the fish are passing our shores and compel them to wait until they get up in front of the door of your house. We can not catch them

until then. I submit, therefore, the argument I make against this bill is a perfectly legitimate one; and, as my friend from New York (Mr. Beach) suggests, you do not want us to have them fresh while passing in schools before our eyes, but want us to wait until you catch and salt them down and then get them from you. Now, I do not believe that you can salt down this House with that kind of mackerel supply. [Laughter.]

Mr. MILLIKEN. What we desire is to give you healthy mackerel in good condition; not permitting them to be taken when, as we believe, they are not suitable for food. We want to save the mackerel alive until it has spawned, in order to furnish a supply every year, and not exhaust them and destroy the possibility of a supply, as you wish to do. Now, we do not care whether they be caught on the coast of Maine, or Delaware, or Florida; all we ask is to protect them from destruction and to protect the mackerel during the spawning season. We do not use the mackerel until they are in a good, healthy condition.

Mr. LORE. There is another reason why this bill should not pass, and it is a strong one in my mind. The catch of mackerel from the 1st of March to the 1st of June along our coast does supply a cheap article of food that is perfectly palatable, food that is nourishing and that is fresh.

The mackerel we thus get from the 1st of March to the 1st of June is far superior to the salt mackerel, even No. 1, that we get from Maine and Massachusetts, and is much more palatable. Then why should we be deprived of the fresh fish that are passing by our doors, and wait until they get up to Maine and Massachusetts to be caught and salted and sent back to us in a salt state? It used to give the sailors the scurvy to eat salt fish. Now, in Delaware we want to have some fresh mackerel occasionally. And we do not want to be confined by a bill like this to Spanish mackerel. You are willing, in your generosity, we should have Spanish mackerel. I suppose that is because they are not caught by your fishermen in sufficient quantities to be profitable.

All we want is to have the privilege of catching a few of these fish as they pass us. Seriously this is a question of cheap food; and it is cheap food for the people who live along the Atlantic coast. There are at times 75,000, aye, 100,000, barrels of fresh mackerel caught off the coast and taken into the city of New York, into the city of Philadelphia, and other cities, which sell all the way up from 5 cents a bucket or basket full. The poor woman can take on her arm and carry to her home a large supply for her family at 1 or 2 or 3 cents a pound. By this bill you would take away that supply at this season when the people need just that kind of food; when they have come through the winter and have not got the vegetables of spring and summer. Just at that time nature has provided this bounteous inflow of food from the ocean. And yet we are told, "Do not lay your hand upon it; keep off and let it get up to Maine and Massachusetts."

As a question of cheap food, I hope this House will not be willing to prevent the people of the Middle States from getting these fish all along the coast by passing a bill of this kind. The whole question is clouded with doubt. The scientists who are engaged in the careful study of this question tell you there is doubt about it. They tell you there is doubt about its decreasing the supply. In fact, it is not decreasing the catch. They tell you there is doubt about every point which has been raised in support of this measure. On the other hand, in opposing these unjust restrictions which are sought to be imposed upon our people we present the fact that by this industry we obtain a cheap supply of food.

I will not weary the House with a further detailed presentation of this matter, but I desire to read just for a moment, on the question of cheaper food, what is stated by Capt. J. W. Collins, who is Assistant Fish Commissioner. He was questioned by the Committee on Ways and Means. Some eight or nine questions were addressed to him. In reply to one of those questions he said:

> The "effect as relates to the cheapness of mackerel as measured by its real qualities as food" has been partially answered above. That the fish caught after June 1 will bring a higher price than those taken before that date goes without saying.

It goes without saying that fish are cheaper that are caught before the 1st than after the 1st day of June. He says further:

> One of the largest dealers in mackerel in the United States has told me that in his opinion the demand for good mackerel could not be supplied if the "inferior trash" could be kept out of the market.

Pursue this plan, keep these fish out of the market, and this expert frankly tells you that the demand can not be supplied. Where would the price go to? Yet you talk of supplying and making abundant this article of food, which for years has been used all over the country.

Let me say, in conclusion, not only am I thoroughly satisfied that the reasons adduced for the passage of this bill are not warranted by the facts, but that the reasons against it are overwhelming.

And I do most heartily and earnestly support the proposition of the gentleman from New York [Mr. Hewitt] that this whole matter should go back to the Fish Commission. They tell you that they have a vessel equipped to go out upon the ocean to investigate the habits of these fish and find out if possible whence they come and where they go, and settle all these questions of supply and modes of fishing. Therefore, I say, send this subject back to the Commission, and when we get their report we shall have something intelligent to act upon, and we shall be enabled to pass laws that will be wise in their inception and just and equitable in their execution.

Mr. STONE, of Massachusetts. Mr. Chairman, I wish to say a few words upon this bill before the vote is taken. As has been said by the gentleman who has just taken his seat, this is a question of cheap food, and if I did not believe that the passage of this bill would improve the quality of this character of food and eventually cause the people of the country at large to have a better supply than they have now, I should not support it.

Professor Baird has been quoted in this debate as not being in favor of the bill, and a letter from him has been read by the gentleman from New York [Mr. Hewitt] which seemed to imply that he was not in favor of the bill, and that he had serious doubts as to its effect. Within a day or two I have seen Professor Baird and talked with him personally upon this very subject. I spent considerable time with him discussing the subject, for, Mr. Chairman, I represent the most important fishing town in the United States, and have been familiar with fishermen ever since I was a boy, and have known, so far as they are known, the habits of the mackerel and the modes in which they are caught. Professor Baird has told me within two days that while he did not feel clear in respect to the effect of this legislation upon the quantity of fish that might be taken hereafter, yet that upon the whole he thought it was wise to pass this bill, because it might have a favorable effect upon the mackerel upon our coast in the future, and that, at all events, he was in favor of trying the experiment.

That was Professor Baird's statement to me within two days. It has been said here, among other things, that there is no proof that the quantity of mackerel has diminished during the last few years by reason of purse-seine fishing. I do not claim, Mr. Chairman, that there is any satisfactory proof upon that point; but I wish the members of this House to take notice of one fact which bears directly upon the question. That fact is that the business of fishing as now prosecuted is conducted very differently from what it was twenty years ago. The fishermen now have the very best and most costly boats; they are all supplied with the best equipments; they are all, or nearly all, supplied with these purse nets. The purse net, so called, is 1,200 feet—nearly a quarter of a mile—long and twenty-odd fathoms deep, and when it is cast around a school of mackerel, embracing as it does an area of 1,200 feet one way and 120 feet the other, gentlemen can conceive of the immense quantity of mackerel it is possible to take at one haul. Now, observe, the fact that the supply for the last ten or twelve years has not decreased does not go to prove that the mackerel may not be diminished by this method of fishing, for the new method has been adopted because it is an improvement upon the old one and enables the men to make a greater catch.

A seine is worth from $1,000 to $1,200, and the fishermen now put into a single adventure $10,000 or $12,000 where they formerly put only $3,000 or $4,000 at the outside. Therefore, the business is now so conducted that the take is not diminished, but it is because these new methods are so effective, and therefore so destructive. Not only are more mackerel, by a great many thousand barrels, annually taken into the city of New York now than were taken there ten years ago, but thousands of barrels are wasted and destroyed because the men take so many fish at a time that they can not handle them all.

The quantity that goes into New York is really no indication of the total quantity taken, but it is clear that the amount taken now in the southern fishing grounds is very much greater than it was ten years ago. The effect is noticed particularly in relation to the quality of the fish. The gentleman from Maine [Mr. Reed] cited evidence as to the quality of the fish in one case, showing that it had very much deteriorated. However, a single instance of that kind is not entitled to much weight in determining the general question, because it may be exceptional. But I hold in my hand the annual report of the Fish Bureau of Boston, giving the quantity and quality of fish taken for more than fifty years, and also an annual statement of the quality of the fish from year to year. The report covers the period from 1809 to 1884. I have made an abstract of it. It appears that for the ten years ending 1885 the amount of No. 1 mackerel taken, as compared with the whole catch, was 225,253 barrels out of 1,880,767 barrels. For the ten years previous, from 1865 to 1875, the number of barrels of No. 1 mackerel was 103,630 out of 317,096 barrels. Thus it will be perceived that from 1865 to 1875 the amount of No. 1 mackerel was little short of 50 per cent, while from 1875 to 1885 it was from 14 to 16 per cent. This shows a very important change for the worse in the character of the fish.

Now, in respect to this very experiment, I desire to say that Professor Baird—to quote him again, because his is the best authority in this country upon the question—Professor Baird has said that he believes it is worth while to try the experiment of this legislation, and I submit, Mr. Chairman, that his testimony should receive the consideration of this House and should be regarded as almost decisive in its effect.

It is said that this movement is almost exclusively in the interest of the fishermen of Maine and Massachusetts. It can not be denied that it is in the interest of the fishermen of Maine and Massachusetts, but it is not urged here to-day because it is in their interest; it is urged because it is believed to be in the interest of the people of the whole country, and almost certain to result eventually in improving the character and the amount of the supply of this food. Gentlemen know very well that Professor Baird, who is a philanthropist as well as an accomplished man in his profession, would not encourage legislation of this kind if he did not believe that eventually it would have a good effect.

Mr. BUCHANAN. Mr. Speaker, the first section of this bill provides—

That for the period of five years from and after the passage of this act, no mackerel, other than what is known as Spanish mackerel, caught between the 1st day of March and the 1st day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores.

The object of the bill is to prohibit the indiscriminate slaughter of mackerel during the spawning season by the use of purse nets. That, as I understand from the promoters of the bill, is its sole object. But the bill as drawn will go further than that in its practical operation. We have all along our New Jersey shore hardy fishermen who in the morning put out to sea in their open boats, and anchoring from 1 to 10 miles from shore, spend the day in fishing for mackerel with hook and line. They thus obtain a livelihood for their familes and they supply, among other places, those numerous seaside hotels which are dotting our shores. I understand that the promoters of the bill do not desire to interfere with this fishery. The number of mackerel caught by the men I have indicated constitutes but a very small proportion of the total catch—is in fact not even a "drop in the bucket," but only one of the atoms that make up the drop. To save the rights of these men I proposed an amendment which has been read. Upon conferring with the friends of the bill I have consented to modify that amendment, and I ask that the Clerk now read it as modified.

The Clerk read as follows:

Add to the end of the first section the following:

Provided, however, That nothing in this act shall be held to apply to mackerel caught offshore with hook and line from open rowboats of less than 20 feet keel and landed in said boats.

Mr. BUCHANAN. I will say that the terms of this amendment are stricter than I like; but they are such as meet the approval of friends of the bill. I earnestly hope the amendment will be adopted. Those who favor the bill have no objection to the amendment, and those who oppose the bill will vote against it whether it be amended or not.

Mr. BRECKINRIDGE, of Arkansas. Mr. Speaker, I wish to call attention to a few of the authorities who, as my distinguished friend from New York [Mr. Hewitt] said, have expressed themselves upon the policy indicated by this bill. They are not, however, as the gentleman believes. Mr. Goode, of whom the gentleman justly spoke in very high terms, made the following statement before the international fisheries exhibition in London some years ago:

The importance of the distinction between the extermination of a species, even in a restricted locality, and the destruction of a fishery, should be noted. The former is somewhat unusual and seemingly impossible in the case of oceanic species; but the latter, especially for limited regions, is almost of yearly occurrence.

Now, the gentleman from New York spoke of what this bill proposes to do as a new proposition sprung upon this House and not properly considered. In this same address, delivered years ago, the same distinguished authority to whom I have just referred used the following language:

There could be no doubt that the extensive fisheries prosecuted by menhaden steamers in the Gulf of Maine were prejudicial to the shore fishermen by driving the fish they formerly caught for bait out to sea and beyond the reach of their nets.

Speaking of the schools being depredated upon before they came in to our shores, he said:

There is also reason to believe that our great purse-seine fisheries for menhaden and mackerel, though perhaps not causing a decrease in the numbers of the fish, have kept them farther from shore. There is a decided disposition on the part of the intelligent men engaged in these fisheries to press the passage of a law which should prevent the use of the purse seine before the 1st of June.

This is the language of Mr. Goode himself, used years ago in his address before that international assemblage at London.

Then Professor Huxley, speaking in the highest terms of commendation of this address, used language which I will read, going to show that some measures of this character are deemed by the most eminent authorities advisable; and certainly no measure could be more moderate than the one proposed, and even this is limited in its duration to five years. This very conservative measure is the response which the House is requested to give at this time to the intelligent demands of the older fishermen. Mr. Huxley said:

The great moral of the United States' contribution to this exhibition, especially of the contribution which Mr. Browne Goode has just made to the conferences, was that if this country, or any society which could be formed of sufficient extent to take up the question, was going to deal seriously with the fisheries and not let them take care of themselves, as they had been doing for the last thousand years or so, they had a very considerable job before them; and unless they put into that organization of fisheries the energy, the ingenuity, the scientific knowledge, and the practical skill which characterized his friend Professor Baird and his assistants, their efforts were not likely to come to very much good.

Now, the gentleman from New York [Mr. Hewitt] was very kind, and I think also very adroit, in intimating the immaturity of those who do not agree with him and a few fishmongers of his city. I stated to the gentleman from Delaware [Mr. Lore], when interrogated by him yesterday as to whether or not this bill had been submitted to our Fish Commission, that I had not submitted this specific bill, but that I had submitted the proposition in the bill; that I had held correspondence with the distinguished Commissioners and others, and I had had also protracted personal conversation with them. And I alluded at that time to the letter which I hold in my hand, and to which I will now make more specific allusion.

When I saw Professor Baird he told me the best authority in the world on this subject was the gentleman who wrote me this letter. Not willing to trust to memory as to the results of a verbal interview, I addressed to this gentleman, Captain Collins, who is the selected expert of Professor Baird and of our Government in charge of this branch of our fisheries, a letter containing inquiries which I thought analyzed the subject, and his letter in response to mine was printed and put at the disposition of the members of the committee and of the House.

I will go over some of these points:

(3) In reply to the question of "what is the effect of unrestricted fishing upon the total weight of catch?" I have to say that this can only be conjectured. With the catch totally unrestricted the amount of mackerel taken between March and June may vary from one-eighth to about one-fourth of the season's catch.

That is the measure of a prodigious industry, which the gentleman from New York and others speak of. The very men who prosecute it thought some sort of a system ought to be established by the only power that claims or possesses the power to establish such system out on the high seas. Laboring men and other consumers of the great bulk of this product are interested in there being a reasonable effort at some sort of regulation.

Captain Collins proceeds:

It is, however, known that about 75,000 barrels of fresh mackerel were landed, and it is claimed that more than that amount were thrown away for lack of a market or because they were unfit for food.

He is speaking of mackerel which are caught out of season—caught during the season when we seek to impose a wholesome restriction, although the business may still be carried on from the 1st of July to the 1st of November, at which period the fish disappear, and with the exception of the limited period of restriction, from March to June, all the ships of the country may go out upon the assembled schools of fish when every fish is in condition to be eaten by man.

Captain Collins proceeds.

Probably 25,000 barrels were salted in the same period. But it is claimed by those best qualified to know, or at least who have followed the mackerel fishery for many years, that if the spring fishery is restricted there will be a heavier catch of mackerel later in the season, when the fish are in much finer condition for food.

Mr. Speaker, that is what this distinguished authority says as to the annual quantity of the catch, that if this restriction be made there will be a heavier catch, and there will not be only this increased supply, but the increased supply will be in a fit condition for food. The bill, therefore, is in the interest of cheap and more abundant food. The fish will be permitted to assemble upon their feeding ground. They will be caught at less expense per barrel, and they will be fit to eat after they are caught. The selling price of good mackerel will be less. But the catch will be so much heavier and the expense of catching so much less, if the fish are permitted to approach our shores unmolested, that the cost of production, if I may so speak, will diminish in a greater ratio than the selling price. Hence, consumer and producer will both be benefited. This bill, therefore, is in the interest of cheap

food to my people and to all the people of the country and yet good for the fisherman, whose recompense is a part of the proceeds of each catch. The advantage is the difference between system and no system. If it were not so, I should oppose the bill. If it sought to restrict anybody's occupation in order to enhance anybody's income, I would oppose it as a piece of class legislation.

It is asserted, apparently with good reason—

Says this same authority, whom Professor Baird says is second in practical knowledge to no one in the world—

that the expensive operations carried on with purse seines in the spring, when the mackerel are migrating north, has a tendency to divert them from their intended course—

The same idea which was advanced by Professor Goode in the London address—

they are driven off shore, and frequently fail to reach their natural feeding and spawning grounds in the Gulf of Maine.

They are dispersed at the very inception of their rising from the depths of the sea. They are not permitted either to fatten or to assemble upon their feeding grounds. How can you net fish or birds if they are dispersed before they get to the trap? Captain Collins further says:

This is believed to be especially the case with the larger mackerel, which, as the season advances, grow fat and become the best qualities known to our market. Where these fish go is not clearly understood, and this is one of the problems which the Fish Commission hope to solve in the schooner now being built with the appropriation made by Congress last winter.

The practical effect of the present system is that the fish are driven away from our people and beyond a point where they can be economically caught by our fishermen. Then further:

The effect upon the quality of the catch, should a restriction be put upon the spring fishing—

Says this same gentleman, who is the best authority, according to Professor Baird, in the world—

the effect would be to improve it very materially. This is well known to everyone who has any knowledge of the species.

The improvement in quality would be due to two causes: First, fish taken before June are poor and thin, but after that date they fatten rapidly and soon reach their maximum of fineness as an article of food; second, if the fish are undisturbed in the spring and allowed to deposit their spawn during the most critical period of their existence, it is believed that the size of the fish will improve very materially and that No. 1 mackerel of full size and best quality may again become fairly abundant in our markets—

Our people being deprived of them now—

May again become fairly abundant in our markets and an article of food for any person of ordinary means.

That is what they are not now, and that is exactly what this bill seeks to make them to the public and to the laboring poor of this country. I should not expect that four or a half dozen fishmongers in the city of New York would see their necessities or show that they sympathized with them in that respect; but it is my belief, on the statement of the best authority, although the gentleman from New York says there is no authority in favor of such a course as this, that such would be the result.

It will be accessible for any person of ordinary means, instead of being so rare that they have become a luxury and attainable only by the wealthy, if attainable at all.

That is the present condition, just the reverse of what is stated by the gentleman from New York:

One thing is certain, whereas mackerel now taken before June 1, as above stated, are always poor and generally small or medium size, those taken after that date are mostly fat fish, and very much more valuable for food, containing a far larger amount of nutritive qualities in proportion to the actual weight of the fish when taken from the water.

He goes on to answer another of my questions:

You ask [said he] will this make mackerel no higher to consumers, but more suitable for eating, hence insuring consumption and the popularity of the fish, followed by the unlimited supply of good fish?

That was one of the questions that I asked and to which I sought an answer, because anything that tends to make food cheaper to our people commends itself to me, and that was the object I had in view in framing this bill.

I have already said something of the price. It should be understood that the price, in accordance with the laws of trade, will be governed largely by the supply and demand.

It is claimed by many, both dealers and fishermen, that a direct result of putting a better average quality of fish on the market would be to increase the popularity of the mackerel with our people, a popularity it once enjoyed in a preeminent degree, and as a consequence the consumption of this species would be much larger than now.

And I will state here that this country now, with all the improved and unlimited appliances to catch fish, with its 120,000 miles of railroads for distributing them into the interior of the country, with its 60,000,000 of fish-loving people, does not consume, taking the per cent as represented by the population, 30 per cent of what it did in 1831. We do not consume as many mackerel now as we did in 1830. We consumed then over 400,000 barrels, and we ought to be able now to give at least 1,000,000 barrels of good mackerel to our people.

And yet this food is to-day higher by nearly 100 per cent than it was in those days.

A balance wheel or regulator—

Says this eminent authority—

A balance wheel or regulator, it may be called, which would prevent the price ever reaching a too high figure under ordinary conditions is this: As soon as the demand improves and anything like reasonably paying prices can be obtained, the immediate result will be a very material increase in the number of men and vessels employed;

Implying that there is no limitation upon that.

And considering the rapid growth of the United States, the accumulating millions to be fed and the greatly increased facilities for transportation, there seems little reason to doubt that, notwithstanding the improved methods for the capture of mackerel, if its former popularity can be restored, the pursuit of this species may in future years, as in the past, employ a fleet of upward of eight hundred sail of vessels instead of less than four hundred, which are at present engaged. This may seem strong ground to take, but when we consider that a catch of upward of 400,000 barrels of mackerel found a market in 1831, with the population of our country infinitely smaller than it is now, the statement will not, I trust, appear to be an exaggerated one.

And this gentleman further states:

The cry of the age is "cheap food!"

Gentlemen will see that I, for my part, am pushing after cheap food, and I was asking my questions of this expert in order to develop the fact as to this being the way to get cheap food. This authority says further:

The average person who goes to market to buy fish for his table can not be expected to be conversant with the different grades of mackerel; at least not enough so to make a good selection. A mackerel is a mackerel to him, and if he chances to get a good one he will return for another; but if the first trial results in disappointment, it can scarcely be expected that the experiment will be repeated. So, although the fish may be cheap, it falls into disuse with a large number of consumers simply because it fails to gratify the needs and expectations of the purchaser, who thereafter prefers to put his money elsewhere.

It is cheap, because worthless. I want it to mature and abound, and then to be cheap because abundant.

I am informed that the dealers and fishermen along the coast of Maine—

Says this authority about men whose petitions have come in great volume to our committee room, men about whom the gentleman from New York seems to know nothing, and whom he does not represent, yet about whom, in the face of their own protests and in the face of the protests of those here who do represent them, he seems to be so solicitous—about these men, says this authority who for twenty-five years was one of them—

I am informed that the dealers and fishermen along the coast of Maine—

And, mark you, every vessel in the Union engaged in the trade that is affected by this bill is a vessel of Maine or of Massachusetts—

are unanimously in favor of restriction.

That is the information which this gentleman supplies. I do not know who got up the petition the gentleman from New York [Mr. Hewitt] has had imposed upon him. It is got up in letter-type style, very unlike what we would expect as coming from the rugged men of the sea, the genuine men of the sea whom we had before our committee and whose petitions we have, men who are very unanimously in favor of restriction; and Capt. Jesse Freeman, formerly manager of the fishing company at Wellfleet, Mass., very positively asserts that all the people on Cape Cod are similarly inclined.

That, Mr. Speaker, is perhaps as much as it is worth my while to say to the House; and I trust the House will give due weight to these opinions I have adduced of Professor Huxley and Professor Goode and of this gentleman to whom I was referred by Professor Baird as the man from whom to get information; nay, he was detained in the city by Professor Baird to give me this information, and he was brought on here ahead of the time he would otherwise have come because we expected early

action, and Professor Baird considered he was better qualified to give the information sought than he was himself. I trust I have read enough from this eminent authority to show the House that many of the statements made by gentlemen are not warranted by the facts; that they are mistakes, and that the bill which is offered here is in the interests of cheap food and better food and more of it, and is a conservative and reasonable bill for us to pass.

The bill passed the House May 21 by a vote of 119 to 88 (119 not voting), with the following amendments: In the first section, the words "passage of this act" were stricken out and "1st day of March, 1887" were substituted; at the end of the first section the following was added:

Provided, however, That nothing in this act shall be held to apply to mackerel caught offshore with hook and line from open boats of less than 20 feet keel.

The fourth section relating to treaties was stricken out.

In the Senate, the bill, as passed by the House, was reported from the Committee on Fisheries by Mr. Palmer, on July 29, 1886, with an amendment striking out the reference to "open rowboats of less than 20 feet keel" and inserting simply "boats." The committee also made a report as follows:

This bill is designed to prevent the taking of mackerel by seines and purse nets between the first days of March and June of the five years succeeding its enactment. It is urged with practical unanimity by the vessel owners and fishermen engaged in this industry, and is opposed only by commission dealers in fresh fish.

The testimony taken by the committee, which has been printed, and is submitted as a part of this report, shows an alarming decrease in the better grades of mackerel suitable for salting as food. The average yearly catch in amount for the years from 1809 to 1872, inclusive, was 166,184 barrels. The average yearly catch from 1872, the time purse nets came into general use, to 1885, inclusive, was 201,204 barrels. It will be seen that the average annual amount caught for the last thirteen years is only about 20 per cent greater than for the sixty-four years from 1809 to 1872, notwithstanding the improved appliances which should have insured a vast increase in the catch, stimulated, as the business has been, by a greatly increased demand from a rapidly increasing population and improved methods of distribution.

Far more to be deprecated than the deficient catch has been the deterioration in quality, as shown by the decrease in percentage of No. 1s. In 1865 No. 1 mackerel was 59 per cent of the whole catch; in 1866 it was 64 per cent; in 1867 it was 58 per cent; in 1868 it was 51 per cent; in 1869 it was 31 per cent; in 1870 it was 21 per cent; in 1871 it was 40 per cent; in 1872 it was 40 per cent; in 1873, the year that seines became generally used, it was 45 per cent; in 1874 it was 44 per cent; in 1875 it ran down to 25 per cent; in 1876 it was only 14 per cent; in 1877 it was 17 per cent; in 1878 it was 9 per cent; in 1879 it was 6 per cent; in 1880 it was 8 per cent; in 1881 it was 6 per cent; in 1882 it was 15 per cent; in 1883 it was 14 per cent; in 1884 it was 8 per cent; and, finally, in 1885, it was 7 per cent.

The fish taken in the time included in the bill, both male and female, are poor, unfit for packing, and not very acceptable for the table. The schools appear on our coast, off Cape Hatteras, in March, and thence proceed northward, and spawn on the coasts of Massachusetts and Maine. On their first appearance the mackerel fleet meets them and they are harried and harassed from that time until winter.

Although it is contended by some scientists that all that man can do will have no appreciable effect in depleting the ocean of fish, it is believed by many that the unrelenting pursuit mentioned above has a tendency to deflect them from their course or to prevent many from returning in subsequent years. This latter fact may account for the diminished percentage of No. 1 mackerel.

The whole mackerel fleet is owned in Massachusetts and Maine, consists of nearly 400 sails, employs about 5,000 men, and is now engaged in seining mackerel from March to November. During April and May of last year the catch was so great that it glutted the avenues of distribution, and many thousand barrels were thrown away. There is some conflict of testimony as to the amount of this waste, but it was probably between 60,000 and 75,000 barrels.

Your committee have amended the bill to allow fuller latitude to the taking of mackerel by hook and line, and recommend that the amendment be concurred in, and that the bill when so amended do pass.

The consideration of the bill was not reached in the Senate until February 8, 1887, when it led to a longer and even more interesting discussion than occurred in the House. The debate extended over parts of two days, and was participated in by a number of Senators whose constituencies were affected by the bill. The following abstract of the principal remarks is given to complete the history of this important legislation. The amendment reported by the committee being agreed to, and another amendment substituting 1888 for 1887 in the first clause of the bill being under discussion, Mr. Palmer, of Michigan, chairman of the Committee on Fisheries, who had charge of the bill, spoke as follows:

Mr. PALMER. I hope the amendment will not be agreed to for this reason: The committee have made the concession which has been offered and accepted because they thought otherwise a hardship would be inflicted upon those who had made preparation for this year.

In answer to the Senator from New York as to whether I think it proper that these men should have notice so that their property can be protected, I will say that the bill was drawn and is being urged by all the mackerel fleet, as far as the Committee on Fisheries know, engaged in the spring catch of mackerel. Their vessels and their equipments have run down in valuation from 25 to 50 cents on the dollar, and it is to save them from commercial destruction, and also to see if the fisheries can not be regulated so that the mackerel will not be driven entirely from our coast and our people deprived of the chief food on which they rely, and upon which they lay very great stress, that this bill is being pushed.

Mr. MCPHERSON. If the Senator from Michigan will permit me, I wish to ask him a question. I see the bill proposes that during a certain season of the year, which I presume is the spawning season, there shall be no catch of mackerel, and this restriction is to continue for a period of five years. Let me ask the Senator if the testimony before the committee, of which I understand him to be chairman, was not to the effect that it was impossible under any condition of circumstances to deplete the sea fisheries? Certain years you have a run of fish of a certain kind and character. For instance, along the Atlantic coast one year we have a great run of bluefish. Again, for a year or two there will be scarcely any bluefish. In certain years we have a great run of the menhaden; and then for a year or two we shall see very many less of them. In my opinion—and my opinion is very largely sustained by experts in fishery matters—there is no amount of catch of fish which can be taken from the water by any process, whether it be by seines or otherwise, that can in any sense or form affect the supply of fish. I think that is a reasonable view to take of the question.

I wish to know why in certain seasons of the year, when there are in some years extraordinary runs of mackerel at the particular season to which the bill relates, it is necessary to prevent the people of the country from having cheap fish food, as they now have in the absence of any law governing and controlling the matter, when it does not and can not in the least particular affect the supply of fish?

I suppose it is very well established that not one in a hundred of the germs ever becomes a living fish.

Will the Senator answer the question I have asked him and inform me whether it was not stated before the committee that it was impossible to deplete the sea fisheries? If he will answer that question, I think he will simply state what ought to be the fate of the bill. Therefore, I will await the Senator's answer.

Mr. PALMER. We know that the first question scientifically, so far as the fish supply is concerned, is not thoroughly understood, and unless scientists are perfectly sure and can demonstrate a fact so that it can not be disproved they are not going to assent to a proposition. The whole theory of the impossibility of the spoliation of the sea has arisen from Professor Huxley's report on the herring fisheries of Great Britain. He spent five years in his investigations, but he did not make a report that is applicable here. He said that nothing that man could do would tend to deplete the sea of fish; but that is not the question here.

We do not contend that there will not be just as many mackerel without this proposed legislation, but we contend that the mackerel will be reduced in quality; that they will be driven off to other feeding grounds.

It is a well-known fact that the anadromous fishes, those fishes that go into the mouths of rivers to spawn, are protected by State laws. The large schools of fish that come upon our coast every year

and feed upon the food that they get near the shore are not protected. The result is that the old and the wise fish that are subjected from year to year to this persecution, which commences at Hatteras and which extends clear to the Bay of Fundy, become wiser, and they are deflected from the ordinary route; they go outside; and the fishermen are catching an unprofitable fish, a fish that is not anything like the mackerel that was caught fifty years ago.

Right here I should like to refer to a table which was prepared by the Boston Fish Bureau, and which more than anything else, it seems to me, establishes the fact that the fish are being degraded by the persecution to which they are subjected upon the coast before they reach Nova Scotia. I shall show that it is fairly deducible from the facts I am about to state. According to the report of the Boston Fish Bureau, in 1819 the catch with the hook and line was 19 per cent of No. 1 mackerel; in 1829 it was 25 per cent of No. 1 mackerel; in 1839 it was 30 per cent; in 1859 it was 61 per cent; in 1869 it was 31 per cent; in 1879 it was 6 per cent. I will state right here in parentheses that the use of the purse-seines commenced in 1873, and from 1875 down to the present time the degradation of the quality of the mackerel on the coast has been so marked as to call for legislative action. From 17 per cent in 1877 it has gone down to 9 per cent one year, to 6 per cent the next year, then to 8 per cent, then to 6 per cent, to 15 per cent, to 14 per cent, to 8 per cent, and to 7 per cent in 1885, showing a remarkable decrease in a very few years.

I think it is fairly deducible from this table that from some cause or other the larger fish are driven from the coast, and unless some remedy is found the fish eventually will not be worth the catching for anything except for fertilizers; they will be nothing but "spikes," as they are called in the market.

There is no doubt in my mind that these fish, by the way they are harassed (and I will bring evidence to bear on that point), are being driven off from the coast. The men who have come and asked for this legislation are unanimous upon the subject with the exception of one man. They ask protection from each other. They ask the enactment of a law that shall prevent one from getting the start of the others. If they were perfectly sure of each other's good faith they would all stay at home; but if nine-tenths of the fleet remain at home one-tenth may go south and get in a very large mackerel catch and carry it into New York and get an advantage over their brethren.

There is no restriction to be placed on the catching of mackerel by hook and line. No one is to be damaged at all except the very men who ask for this legislation. They are the men who supply our navies with our sailors. We are now agitated in an attempt to protect them in their rights; and it seems to me that their voice should be heeded in legislation which tends to their prosperity and the prosperity of the fisheries. Unless something of this kind is done, I am perfectly certain that there will be no mackerel fisheries with purse seines—possibly that would be a blessing—in less than ten years.

I should like to read from some of the testimony presented to the committee. These letters are from men who have pursued fishing or have been connected with it in one way or another all their lives. Here is a note from W. A. Wilcox, manager of the American Fish Bureau. I read an extract from his letter of June 15,1886:

> From personal conversation with a number of the most reliable masters of vessels engaged, I find they estimate the aggregate amount thrown away by all vessels engaged at from 75,000 to 100,000 barrels.

That is, from 75,000 to 100,000 barrels a year. It shows how the catch has deteriorated. The fish could not be marketed. They are thrown over at sea, the most of them, and that is another crying evil.

Mr. Miller. Will the Senator allow me to ask him a question? How does this bill prevent the catching of mackerel by purse seines? How does it enable the fishermen to catch only the good fish and to leave out the poor ones?

Mr. Palmer. If the Senator from New York can tell me why they should catch fish when they can not sell them, then I can tell him how it would prevent it. The bill proposes to enact "That for the period of five years from and after the 1st day of July, 1887, no mackerel other than what is known as Spanish mackerel, caught between the 1st day of March and the 1st day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores——"

Mr. Miller. But if the bill said that no mackerel caught in purse seines or in any other way except by hook and line should be imported into the United States, I could then understand how the bill would enable the fishermen, or would compel them, to bring in full-sized fish; but it does not undertake to regulate the methods of fishing at all.

Mr. PALMER. If the Senator from New York had allowed me to read a little further he would not have made that remark.

Mr. MILLER. Certainly I should have made the remark.

Mr. PALMER. "*Provided, however,* That nothing in this act shall be held to apply to mackerel caught with hook and line, from boats, and landed in said boats, or in traps and weirs connected with the shore."

Mr. MILLER. We understand what that means. That means fishing within the limit of 3 miles from the shore.

Mr. PALMER. I think the Senator is mistaken; it is not offshore, it is outside of the 3-mile limit. But it does not refer to anything in particular that the committee or the persons who are urging the bill desired to accomplish; they are perfectly willing to let them fish offshore, inshore, up the creeks, anywhere they please, as long as they fish with hook and line.

Mr. MILLER. So long as they do not catch any fish before the 1st day of June. After the 1st day of June they can fish anywhere, with purse nets, and take any sized fish, as they have been doing for years. Is it not true that that can be done under the bill?

Mr. PALMER. If the Senator will allow me, I will explain why the limit was put at the 1st day of June. There were many who wished to have it put at the 1st of July, but they said they were fearful they could not get it through if that limitation was made, and therefore it was fixed at the 1st of June; but practically it amounts to the same thing, for when the mackerel spawn, between the 1st of June and the 1st of July, they sink out of sight, they do not appear at all; so that practically it is a close season for the females and their progeny up to the 1st of July.

Mr. MILLER. I am very glad to have the Senator make that admission. Then this proposition is that there shall be no fishing for mackerel except during the spawning season, and you may then catch all you like. That is a new way of regulating fishing. In the internal waters of the United States, by the laws of nearly all the States, fishing for the various kinds of fish like trout, bass, and others is prevented during the spawning season. Now, the Senator tells us the spawning season for mackerel is between the 1st of June and the 1st of July, and that is the time persons are to be allowed to catch them, under the bill.

Mr. PALMER. The Senator is a little too technical. I shall have to go into the history of the mackerel from the time he comes on to our shore at Cape Hatteras, and follow him up through New Jersey, up by Block Island, until you land him in the Bay of Fundy. When the mackerel comes on to our shores from the Gulf Stream, or from the open sea, or wherever he may come from, which is not already established, he is poor; both the male and female are poor. The reproductive process has commenced and they are poor up to the 1st of July, when the spawn has been distributed and when they commence to feed upon the red food along the coast in Massachusetts and Maine. Then they soon become fat and a good marketable article. I do not see that the inference which the Senator from New York draws can be fairly deduced from anything in the bill.

Mr. MILLER. If the spawning season begins on the 1st of June and extends until the 1st of July or August, in order to make it safe, why does not the committee provide in the bill that there shall be no fish landed upon our shores from the 1st day of August of each year up to and including certain other months, December or January?

Mr. PALMER. The committee did not provide for it because it was not asked for.

Mr. MILLER. The committee certainly ought to provide for what is just and right without any regard to what the salt-mackerel men may ask.

Mr. MCPHERSON. If the Senator will yield to me a moment, he has described the habits of the mackerel striking the coast on the south about Cape Hatteras. The Senator well knows that from Cape Hatteras to the northern coast of Maine, on almost every rod of territory, there are constructed, as a sort of permanent investment by the fishermen, weirs and ponds and places of that kind for the convenience and the profit of the fishermen.

Mr. PALMER. If the Senator will permit me, that is provided for in the amendment.

Mr. MCPHERSON. At certain seasons of the year there is a run of mackerel, at certain seasons there is a run of bass, at a certain other period there is a run of bluefish, and so on. The operation of the bill will be to destroy absolutely the occupation of the fishermen during the months of the year in which the bill provides that no mackerel shall be caught.

Mr. PALMER. If the Secretary will read the amendment which relates to traps and weirs the Senator from New Jersey will see that it will cure the evil of which he speaks. The weirs and nets

are specially exempted from the operations of the bill. All the men along the coast of New Jersey, Delaware, and Massachusetts who have weirs or nets connected with the shore are particularly exempted from its operations and will derive increased benefits from this legislation.

Mr. McPherson. In that respect the bill is bettered by the amendment. There is one other question which I should like to suggest. I have somewhere read a statement made by a certain professor in Scotland who has made quite a study of the fish question, and particularly of the question of the herring upon the coast of Scotland. It is well known that there is not to be found elsewhere on the face of the earth, in any water anywhere, such a great fishery enterprise as the herring fishery on the coast of Scotland. Some years there is a less run of herring than others. This professor goes on to say that as to the amount of herring caught from the water by all the processes which fishermen can employ, whether it be by nets, by seines, by weirs, by hook and line, or what not (and we know something of the quantity caught), the amount of fish taken on the coast of Scotland was as one to a million compared with the amount of herring consumed by other fishes.

I should like to ask the Senator from Michigan what is the necessity of preventing cheap food-fish being obtained for the people, even during the period proposed in the bill, if it be true that for every fish taken from the water at any season (and it is well known that the herring fishery is prosecuted with more vigor and with more profit during the spawning season than any other) a million are consumed by other voracious fishes? We know that one class of fish lives upon another. Then why, upon the seacoast, with an ocean 3,000 miles wide, is it necessary by any sort of system whatever to prevent the free occupation of the fisherman during any months of the year?

Look at the menhaden fishery. Within a year or two we find that the menhaden have very greatly reduced in numbers, so that in some years it is almost impossible for the men employed in the industry of catching the fish for the oil and the fat, which I understand is made into fertilizers, to find enough menhaden to profitably occupy them. In other years, again, the menhaden come in immense quantities. I think it safe to say that although legislation has been attempted here and elsewhere to prevent fishing for the menhaden along the coast, for every fish taken from the water by the menhaden industries there are a million of them consumed by other fish. If it be best to prevent fishing near the shore in order that the fish may go back into deeper water and be caught there by bigger fish, then there is some justification for this legislation; if not, there is no justification for it.

The Presiding Officer. The Secretary will report the pending amendment proposed by the Senator from Massachusetts [Mr. Hoar].

The Chief Clerk. In section 1, line 4, it is proposed to strike out "1887" and insert "1888," so as to read:

> That for the period of five years from and after the 1st day of July, 1888, no mackerel other than what is known as Spanish mackerel, caught between the 1st day of March and the 1st day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores.

Mr. Frye. I ask the Senator from Michigan in charge of the bill to move to reconsider the vote by which the bill was amended by striking out the word "March" and inserting the word "July," in line 4, and then to accept the amendment offered by the Senator from Massachusetts.

Mr. Palmer. In deference to the wishes of the Senator from Maine, who has a greater interest in this bill possibly than I have, I will move that the vote by which the amendment was agreed to, changing "March" to "July," in line 4, be reconsidered.

The Presiding Officer. That can be done by unanimous consent. There being no objection, it is so ordered.

Mr. Palmer. Now, I withdraw the amendment.

The Presiding Officer. The question recurs on the amendment proposed by the Senator from Massachusetts [Mr. Hoar]; which will be read.

Mr. Saulsbury. Mr. President, during the examination of the fishery question last fall we took considerable testimony before a committee, of which I was a member, on this very subject. I found that the men who own the boats as a general rule were in favor of a close time, as they call it, but they stated that their men employed in doing the fishing generally urged that they should send out their boats to the spring fishing. Not willing to lose the time, they urged the owners of vessels to send their vessels down the southern coast in order that they might have employment.

My understanding is that there is a very considerable amount of fresh mackerel consumed in the eastern cities caught between the months of March and July, which furnish cheap food to a class of people who are not very well able to buy the higher-priced fish. If the bill proposes to restrict that

it seems to me that it is wrong. As to whether it affects the mackerel fishery subsequently, the fall fishing for mackerel, I am unable to say.

There are different theories in reference to the mackerel. Some fishermen whose testimony was taken by the committee had an idea that these fish come up from the Gulf along the shore, striking in about Hatteras and going all the way up. There were other persons who had the idea—and I think Professor Baird has that idea—that they come directly into the shore from the sea. If the latter theory is true, then all the argument in reference to diverting the fish is erroneous. If, on the other hand, it is true that the schools of fish come up from toward the Gulf and hug the shore clear up our coast and to Canada, then perhaps the spring fishing does divert to a certain extent the fish from our coast. Which of these theories is correct I am not able to say, but at any rate, if the poor people of the cities are to be deprived of a cheap article of food it seems to me that this proposed legislation is not wise.

As to its effect upon the ultimate catch of the fish I am at a loss to determine, because that depends also upon the theories which are entertained in reference to the habits of these fish. If they make into shore from the sea, striking at Hatteras, striking along the Jersey coast, striking along the coast of Massachusetts and Maine from the sea, then there is no diverting the fish, if that theory be true, simply by fishing down about Hatteras in the spring of the year.

My information is that there are about a hundred vessels that go down from Gloucester and from other points on the New England coast and engage in southern fishing; and that they do not go because the owners of the boats desire that they shall go, but because the men engaged in fishing, the hands who do the catching, do not wish to be lying around Gloucester all the spring waiting for the fall catch, but they desire to be employed. The bill operates to the prejudice of that class of men who are dependent upon their labor in this industry. If it is their wish to go down and fish, and if the poor people of the cities are to be deprived of a cheap food, the bill is contrary, in my judgment, to what is right. The poor we shall always have with us, and we ought not to legislate against their interests.

I had a good deal of doubt about the justice of this proposed legislation when on the committee last fall, after hearing the testimony of the owners of the boats, for it was the testimony of the owners of boats that we took as a general rule, and not of the men engaged in actual catching, except the captains of the boats. I do not now remember that I heard any expression of opinion from the captains of boats on this subject, but we did hear some opinions adverse to the spring catch by the owners of the boats, and I think very generally the owners of the boats were opposed to that kind of fishing; but I understood distinctly from the owners themselves that they were compelled to engage in spring fishing because their fishermen were not willing to wait, and they had to send them out to gratify the men actually engaged in the fishing.

If the statement of the Senator from New Jersey [Mr. McPherson] is correct, that it is utterly impossible to diminish by any catch the fish, then all the arguments in favor of a close time comes to naught. We have an abundance of fish during certain seasons, it is true, of certain kinds of fish, and at certain other seasons there is not so much. I know that in Delaware Bay, along which I live, in some seasons of the year we have the sea trout, which comes in there in great abundance, and perhaps the next year there will be but few of them, so that it alternates, sometimes a full season of fishing and sometimes a scarcity. It is so, I believe, with shad, and it is so with herring, and I suppose with every other class of fish.

On the whole, I think I shall vote against the bill.

Mr. Miller. Mr. President, this is a very ingenious bill. It could have had its birth nowhere except in the fertile mind of a down-east Yankee, and if it is passed into a law it will undoubtedly succeed in accomplishing what it was intended to accomplish, for it is very neatly drawn for that purpose.

The object of the bill is to reduce the catch of mackerel from one-third to one-half of all the mackerel that shall be brought into our American ports during each year. The fishing season begins late in March or early in April and continues uninterruptedly up to the 1st of June, and through June, July, August, September, October, and November, even to December, as the Senator from Michigan says; but during the month of June and a portion of July the fish disappear and the catch is small. Heretofore the principal catch of mackerel has been made off our coast during the months of March, April, and May.

Mackerel fishing has been a very important industry. It has given employment to a very large number of hardy seamen. There are engaged in the business, I think, nearly two hundred vessels,

owned largely in Massachusetts and New York, some in New Jersey and other States. The bill takes off three months of the annual fishing, and three months of the best fishing.

The chairman of the committee, who has made a scientific stndy of this matter, tells us that the fish first appear off our coast off the capes—Cape Hatteras, or even farther south, opposite Georgia and South Carolina—late in March or early in April, and that from that time on up to the 1st of June they are found going farther north, until finally in June they are off Massachusetts and Maine; in other words, that this is a bill to prevent fishing for mackerel save off the coast of Massachusetts and Maine, chiefly off the coast of Maine, for after the 1st of July the fish are as far north as Maine, and many of them have gone still farther north.

Whether the chairman of the committee took kindly to this measure or not I do not know. It may be that there is some New England blood in his veins, and therefore he took kindly to this proposition of his fatherland. As the State of Michigan does not border upon the Atlantic, he has no mackerel fishing off his shores, and he may have been kindly disposed toward New England and been willing to rule out of the fishing business all the Southern States and the States of New Jersey and New York. I will not say as to that, but certainly I was greatly surprised to find that the Senator from Michigan, who usually takes so liberal a view of all these questions, and who desires to legislate in the interests of the people of this country, should have given his sanction to a bill which is simply for the purpose of creating a monopoly in the mackerel fishing off our shores.

This bill is simply in the interest of the men in Massachusetts and Maine who are engaged in the salting of mackerel, and is intended to cut short the fishing which takes place along our shores, and which produces during the months I have spoken of one of the principal food-fishes of this country, being brought into all our ports in enormous quantities, and now by our railroad system distributed all along our coast, even as far west as the Mississippi Valley.

What reason can be given for this bill I do not know. I have waited anxiously for the Senator from Michigan to give us some reason for the bill. He seems to defer those reasons until the opposition to the bill shall be put in, and then I suppose some overpowering and conclusive argument may be produced here which will convince us that we have all been wrong. Certainly, if such reasons are produced by the members of the committee or by any other Senator, and my judgment is convinced, I shall gladly acknowledge my fault and support the bill.

It has been intimated that the fish were not good during the months included in the bill, but the Senator tells us that the spawning season does not begin until June, and he proposes to curtail and stop absolutely the fishing for mackerel until the spawning season begins. I submit to him as an old fisherman and one skilled in the art, and as one knowing the science of the fishes, that it is certainly a very curious provision that he should bring in a bill here regulating fishing which should prevent fish from being caught at any other season of the year save during the spawning season. I shall leave him to explain why he has done this.

Mr. President, this legislation is certainly anomalous. As I said a moment ago, it is in the interest of monopoly. It tends directly to create a monopoly. It proposes to put a fence around the Atlantic Ocean for three months in the year, and say to the poor and hardy fishermen of our coast, "You shall not go out in your boats to catch any mackerel, or if you do catch them you shall not be permitted to land them upon our shores."

Evidently the amendment which the Senator has proposed this morning, allowing these fish to be taken in weirs, nets, and pounds along the shore, has been intended to catch the support of the Senators from New Jersey, off which coast much of that kind of fishing is carried on. But if the fishing is injurious; if, as he tells us, the mackerel are harassed and troubled by the fishermen until at last they are driven away from our coast and we have only the small mackerel of which he complains left, how does he better it by allowing fishing off the shore in weirs and pounds and nets? Will not all the fish be taken, of whatever size they may be? Certainly everything that comes to the net will be taken in, it matters not whether the net is on the shore or off the shore or whether out in the deep sea.

We have allowed American citizens to go out upon our great plains and to fence in the public domain and to drive off and keep off citizens of the United States from settling upon it. We have allowed great corporations to seize upon the public domain, and to-day there remains but little of the public domain which is desirable for settlement and which can be taken under the laws of our Government. We are rapidly making a monopoly of whatever of public land there is left in this country; and now these few men in the States of Maine and Massachusetts, who desire to control absolutely the

mackerel market of this country and to raise the price of mackerel in our market from 50 to 100 or 200 per cent, as this bill will do if it passes, come here and ask us to put a fence around the Atlantic Ocean and to say to our people, "You shall not fish during March, April, and May."

It seems to me that it ought only to be necessary to read the bill and to call the attention of the Senate to it in order to have it unanimously rejected, for I can not believe that the Senators from any State, representing their constituents, can for a moment consent to stand here and indorse and advocate a measure which is to make not only mackerel dear in our markets, but which is to make all salt-water fish dear also; for you will find, if you go to the great fish markets in New York and other seaports, that the price of bluefish, the price of sea-bass, and in fact the prices of nearly all salt-water fish are largely controlled by the amount of fresh mackerel brought into our ports. Mackerel is the principal fish, and if it comes in in greater abundance the price goes down, and that carries with it, of course, the price of all other salt-water fish. If the number that is brought in is decreased, necessarily the price of mackerel advances and the price of other salt-water fish advances.

It so happened that about two years ago, I think, a great catch of mackerel was made off our coast. Mr. Blackford, who is one of the fish commissioners of New York, a man who knows as much about the commerce in fish as perhaps any man in the United States, for he has been engaged in it for many years, tells us something about the results which happened upon the price of fish when the great catch was made only a short time ago. Let me read from his testimony, which was taken by this committee. Mr. Blackford said:

> As I said when I was before your committee formerly, last year was an exceptional year there being an enormous catch. The mackerel made their appearance about the 1st of April, and in the sixty days between the 1st of April and the 1st day of June there were some 60,000 barrels landed and distributed, not in New York City alone, but all over the country; that is, within forty-eight hours of New York City by express.

Mr. President, if you will look at the statistics of the mackerel catch of this country you will find that the 60,000 barrels were one-quarter of all the mackerel taken in that entire year. If this bill had been a law those 60,000 barrels of mackerel would not have been taken at all, and they would have been lost to the people, and the result would have been a largely increased price for fish.

Mr. Blackford goes on to say:

> They were sent in large numbers to Chicago, to Cleveland, St. Louis, and as far south as into Virginia and North Carolina, and I do not know but that a larger quantity were shipped to the State of Massachusetts than any other State; the demand for fresh mackerel there is greater. Those 60,000 barrels do not represent all that were taken in the earlier part of the season. The whole fleet of one hundred and seventy vessels happened to strike the mackerel all at the same time, and New York was the great market. The whole fleet came to New York, with the exception, probably, of half a dozen vessels that went into Philadelphia or other ports. It glutted all the usual avenues of distribution. They came in such enormous numbers there that they could not be distributed through the usual channels in time to avail ourselves of them before they spoiled. The fact is probably familiar to you that men, women, and children flocked to the docks with their baskets, and it was not a question of price. If they had 5 cents they could fill a basket. If a peddler came here with a wagon he could get his wagon loaded for 25 cents, and in the distribution by rail and express the dealers simply barreled them up and marked the names of reliable dealers in this city and that, and shipped them off for the dealer to take and pay whatever he saw fit. I speak of this in order to show you that during these two months mackerel formed a very important factor as a cheap food supply of good quality.

The Senator from Michigan tells us that this is destroying the catch of No. 1 mackerel. Perhaps that may be true, but 90 per cent of the people of this country do not eat No. 1 mackerel; they do not ask for it in the grocery stores; they can not afford to pay the price for it. The people of this country want cheap food, and under the present system of fishing they are getting it, not only all along our Atlantic coast, but, as I have shown, as far into the interior as the Mississippi Valley itself.

How does this large catch of fish affect the price even of No. 1 mackerel? I might go on and read a long time to show how it reduced the price of a barrel of salt mackerel at that time nearly 50 per cent.

It is not necessary that I should say here that the price of mackerel, like the price of other commodities, depends upon the supply and demand. The bill proposes to cut off one-half the supply and thereby raise the price of the other half to at least double the present price.

While the catch of mackerel has decreased since purse-seining has been introduced, it does not follow that it should be given up, nor does the bill provide that it shall be given up. If the bill had provided that at no time should any mackerel be landed upon our shores save those taken by hook and line, we could then have understood that the committee and the Senator from Michigan had brought the bill here for the purpose of preserving the species of mackerel and providing that only the large fish should be taken and that the small fish should be left. But it does not do anything of the kind.

Mr. Palmer. Will the Senator from New York permit me to interrupt him? Is not that essentially the effect of the bill? The Senator seems to be confused on that point. If the Senator will read the proviso at the end of the first section I think he will be enlightened.

Mr. Miller. I have read it two or three times, and we all understand it. That permits fishing with hook and line during the three months specified, but after that time is up, for the other nine months in the year, purse fishing goes on uninterruptedly off the coast of Massachusetts and Maine; but it can not take place off the coast of any other of the United States because the fish are not there except during those three months. That is the meat in this little bill. I say if the committee had come in here with a bill providing that no mackerel should be landed upon our coast save mackerel taken by hook and line, it does seem to me that the Senator might have stood upon some scientific ground, upon some just ground, and said to the Senate that he was afraid the entire species of mackerel would be blotted out and withdrawn from the sea, and he was doing this to preserve the species. But that is not the case at all. Mackerel can be taken by purse seine any time after the 1st of June, any time after the fish have gone as high up as Massachusetts and Maine, but not before.

The catch of fish is not falling off at all. The Senator says there have not been as many No. 1 mackerel taken recently as heretofore. Quite likely that is true, but, as I have said, the masses of our people are not buying No. 1 mackerel; they want cheap mackerel and cheap food of all kinds. I do not know that the entire catch of mackerel is given here. I suppose not, but it is the amount inspected in Massachusetts only that is stated in the report. In 1876 it was 225,000 barrels. The next year it fell to 105,000 barrels. Evidently that was a bad year for mackerel. The next year it went up to 144,000 barrels, and the next year 155,000 barrels. In 1880 it got up again to 243,000 barrels. The next year it was 256,000 barrels, and in the next 258,000 barrels. The next year—another bad year—in 1883, it was 154,000 barrels. The next year it went up to almost its largest point. In 1884 it was 283,000 barrels, and the next year it fell to 215,000 barrels.

There is not anything to show in the statistics of the country (for there are no such statistics) that we are depleting the seas or that we can in any way destroy or perceptibly affect the supply of food-fish in the sea. What are caught by all the human race constitute a mere nothing in comparison to the vast multitudes that inhabit the sea.

Here is a food suitable to all our people. It costs no man anything to cultivate or raise. It roams at its will through the sea. It costs us nothing and never has cost us anything. We have been appropriating a few thousand dollars from year to year to enable our scientific men to study the habits of sea fish and to see if they can do anything to bring them closer to our shores and to make our fisheries more effective. In the increase of our food-fish in our interior waters they have undoubtedly been very successful, and are doing much to resupply the streams and lakes which were giving out. But thus far they have produced no results whatever upon sea fish. They have been enabled to make some studies which are useful and I hope will lead to beneficial results, but in regard to mackerel they have not been able to arrive at any conclusion about their habits. They do not know where they go to nor where they come from. They simply know that during certain months they are off a certain portion of our coast and that we can then catch them, and that is all they know about them. Let me read from a letter written by Professor Baird on this subject:

United States Commission of Fish and Fisheries,
Washington, D. C., February 15, 1886.

Dear Sir: I have received your letter asking for an opinion as to whether "the preventing of mackerel fishing during the spring months is necessary for the maintenance of an abundant supply of that fish upon our shores." I have never been convinced that the abundance of mackerel has been in any way affected through the agency of man.

Here comes this committee, and it proposes to say that for three months in the year no mackerel whatever shall be landed upon our coast. There can be no possible excuse or demand for such legislation unless it be upon the ground that it is necessary to preserve the fish and to prevent them from being obliterated.

Mr. Palmer. Will the Senator permit me to make a statement?

The Senator seems to have gotten up a fog bank, and thinks it is a positive clay bank, and he is pelting that. There is no charge that there has been a diminution in the quantity of mackerel. That is not the charge, although I believe that will follow the purse-seine fishing if kept up for many years, but the charge is in the degradation of the quality.

Mr. Miller. May I ask the Senator what is the reason for this bill? Why is it brought in here?

Mr. Palmer. In answer I will state that it was brought here at the instance of men who are engaged in the mackerel fishery, who represent 400 vessels and 5,000 seamen, who say that by reason

of purse-seine fishing, as they believe, the mackerel fishery has become unprofitable, and that they will sell out at from 25 to 50 cents on the dollar their vessels and all their equipments. They say it is a matter of vital interest to them, and that without some legislation the mackerel fishery of the Northeast will be destroyed entirely, and they will have to go back to the old hook-and-line methods.

The Senator says that what he wants is cheap food for the people. He will have high food for the people without some such enactment, because this matter of purse-seine fishing will cure itself sooner or later. The best thing for him to do is to accept the inevitable. Let these poor and miserable and cheap, and I would say if I ever used the word, nasty fishes of the spring go, and rely upon the hook and line to supply his constituents, and in the fall get fish that are worthy to eat at a cheaper price than he can get them if the present system is permitted to go on.

Mr. MILLER. The Senator has answered my question as I expected he would. It turns out that this bill is in the interest of the owners of a few fishing vessels, not in the interest of the seamen who go upon them, as the Senator from Delaware [Mr. Saulsbury] told us was disclosed in the investigation which was had before a committee of which he was a member.

I undertake to say, and I do not think it can be gainsaid or disproved, that this bill is desired simply by a few men who stay upon the land in various towns in Maine and Massachusetts and salt down mackerel. They are men of capital, men of means. It is not asked for by the poor fisherman himself. He does not desire to be deprived of three months of his work in each year. It is not asked for by the ten million or the fifty million people who consume this food.

As to the quality of the fish, I do not care to go into that, but I think when every Senator here can get a good fresh mackerel between the 1st of April and the 1st of June he does not hesitate to eat it. I know I do not. I have no doubt but that the Senator from Michigan, although I know he is very particular in regard to his food, eats fine mackerel between the 1st of April and the 1st of June.

But, as I said a moment ago, even if the object of this bill be what the Senator says it is, it effects that object only for three months. It does not stop purse-seining during nine months in the year. Why not? If it were true or if there were any fair probability that by the continuation of purse-seining all the mackerel would be driven off our coast and the whole fishery disappear and our people leave this food fishery entirely, it might be wise for us to pass a law providing that no mackerel should be landed upon our coast at any time save those taken by hook and line; but this bill does not provide anything of the kind. The Senator from Michigan wants to preserve, to take care of the little fish, the weak fish, and the poor fish during three months in the year, and then he turns them loose to the mercy of those men whom he is representing here, the fishermen of Maine and Massachusetts, and allows them to go out with their purse-seines and surround the whole sea and bring them in, and they bring in large and small then, just as much in the months of June and July as they do in the months of April and May, do they not? I ask the chairman of the committee if that is not true? There can be no question about it. This bill, then, is not consistent with itself. It does not undertake to accomplish what the Senator says it is intended for.

Mr. PALMER. The Senator asked me a question. I shall be very glad to answer it.

They do not bring the fish in in the same shape in July and August; they are not brought in salted. It is a fact that the fish caught in July are not fit for salting.

Mr. DAWES. I should like to ask the Senator from New York if he has not overlooked the fact that the fish, when they first come upon our shores in March, April, and May, are poor, small fish; that they become larger and fatter after that time and more fit for the market; and that the object is to preserve the fish until they become fit for the market and not bring them in, as he has described, 60,000 barrels at one time, and allow them to be dumped into the docks and thrown away, more than half of them, because it was impossible to consume them at any price or give them away before they were destroyed. Is not that the object of this bill?

Mr. MILLER. I am trying to get at the object of the bill, and we shall be able to fish it out after a while, even if we have to do it with a hook and line. I have been throwing out a purse seine and got nothing. The reasons were so small that they slipped through the mesh.

Mr. DAWES. I suppose that a man who recognized the fitness of the game law in his own State and in every other State of the Union that prohibits the taking of game during certain months in the year in order to preserve the game, so that it may be fit for market in other months of the year, would be able to guess, without the benefit of a hook and line, what was the purpose of this bill.

Mr. MILLER. If there was anything of that kind in this bill I might perhaps have guessed at it; but there is not. There is nothing in the bill that will accomplish anything which the Senator from Massachusetts has just stated to be the object of the bill. It will not accomplish it at all.

Mr. DAWES. The Senator will allow me to interrupt him again.

I stated to him that during those months the fish were young and poor fish; that they came up better fish in the after months; and the Senator's attempt to show that this is for the benefit of the men who own shipping craft in Maine and Massachusetts shows that he understands that part of it just as little as he does the game laws of his own State. It does not make a particle of difference with the men in Maine and Massachusetts whether they fish down in New Jersey and off Hatteras, or fish in Massachusetts or Maine. They do not go home at nights; they are out on the ocean; and it does not make one particle of difference where they go for the fish. The effect is upon the fish and the fish market in the long run, not upon a man whose business it is to get 60,000 barrels at one haul, and make a lot of money by dumping them around in the different express offices of the country. That is the difference between the Senator and this bill.

Mr. MILLER. If I did not answer all the questions and all the objections of the Senator from Massachusetts, it was because the questions were so long that I forgot most of them before he finished.

I do not suppose the Senator from Massachusetts or the chairman of the Committee on Fisheries will undertake to say that the mackerel grow from a little fish to big fish between the first day of April and the first day of June. That is absurd. It takes several years to grow a No. 1 mackerel, the kind that the Senator from Michigan uses upon his table. They are not grown in ninety days.

Undoubtedly it is true that the mackerel in the months of April and May are not quite as fat, not quite as oily, as they are in September and October, but it is also true that the mackerel during the three months I have mentioned—March, April, and May—are perfectly good food, and are eaten by the greatest epicures in this country, with all due deference to the chairman of this committee and to the Senator from Massachusetts.

If by purse seining they get too many of the small fish, this bill does not prevent it, except for three months in the year. As I have said before, it leaves the other nine months unrestricted. Now, if these fish are unfit for food during March, April, and May, why, I ask in the interest of the health of our people, does the Senator from Michigan come in here and permit you to eat those which are taken by the hook and line or are taken in a pound net, or in a weir off the coast of New Jersey during these three months? Are those fish which come a little closer to shore any better in March, April, and May than the fish taken out in the open sea? I think not. The fact remains simply that the fish in those three months are not as good as they are during the rest of the year, but they are perfectly good food and are eaten by all our people who can get them at a reasonable price.

The Senator from Massachusetts referred to the game laws of my State and of other States. Sir, we do not have any game law in the State of New York which forbids fishing for trout and bass except during the spawning months. We have not got any such law as that, and that is what this bill is. This bill says you shall not begin fishing for mackerel in the high seas until the spawning season begins, and then you may fish all you like. Who ever heard of such a game-preserving law as that is? It is absurd on the face of it; and I say when a law is made with that absurd provision you must go and look at the selfish interests of the men who brought the bill here and who have advocated it before the committee and who have appeared there and made their arguments. The thousands of poor fishermen who go out in these months and partake n this industry have not been here asking for the passage of this bill, but only the capitalists; and they have found that we are catching so many fish under the present system, that we are so reducing the price even of No. 1 mackerel, that they with their capital may no longer find it profitable; but I have no fears in regard to that. This great industry will not be allowed to die and pass away because of its enormous proportions. It does not cost us, as I said a moment ago, anything to grow these fish. Providence takes care of them, or they do themselves, and all we have to do is to catch them and distribute them among our people.

One other point mentioned by the Senator from Massachusetts I desire to refer to, and that is the enormous catch that took place two years ago, of 60,000 barrels taken by a fleet of 170 vessels, nearly the whole of which was brought into the port of New York, and from there distributed, as I have shown, all over the country east of the Mississippi River. The Senator dealt, I think, in a little exaggeration, not intentionally, in stating that one-half of them were dumped off the wharves and allowed to go to waste.

Mr. DAWES. I did not say they were dumped off the wharves. They were taken to express offices.

Mr. MILLER. I said one-half. I did not say the whole.

Mr. DAWES. I say the Senator was mistaken when he said I stated that one-half had been dumped off the wharves. I said one-half of them were disposed of in some way; that is, dumped off the wharves, sent to express offices, and thence away off at a distance in such large quantities that they became useless and could not be eaten at all.

Mr. MILLER. The statement of Mr. Blackford does not bear out that statement of the Senator.

Mr. DAWES. The whole statement in the book the gentlemen has before him on that subject bears out what I said.

Mr. MILLER. Perhaps it may; I will not undertake to say in regard to that; but I say the statement of Mr. Blackford, who has more information about it than any other man in this country, does not bear out the statement of the Senator; and even if it did it would be no argument at all in favor of this bill, for there is nothing in this bill that will prevent the 170 or the 400 vessels, as I think the Senator from Maine said, engaged in this business from catching, after the 1st day of June, all the mackerel that go to their seines, it may be 120 barrels in one haul. There is not anything in the bill to prevent that.

It so happened that two years ago this fishing fleet went south, and off our coast it struck the mackerel as they were coming in to our shores, and, like wise fishermen, they filled their nets and filled their ships, and brought them into port, and they brought in 60,000 barrels and they were distributed over the country, and the estimate of Mr. Blackford is that perhaps 6,000 barrels out of them all were wasted because they were spoiled before they could be properly distributed, but that is a thing that never happened before and may never happen again, and there is nothing in this bill to prevent its happening every year.

I was attempting to show that it was impossible for man, in any way, to control the fishes of the sea and their supply, or that we had any exact information regarding them, and therefore that it was worse than folly, that it was criminal on our part to attempt to curtail the supply of food to our people by fencing in the Atlantic Ocean for three months and preventing our fishermen from fishing. I was reading a letter from Professor Baird when I was interrupted. I will go back in the letter.

I have never been convinced that the abundance of mackerel has been in any way affected through the agency of man. The catch in 1884 and 1885 was far above the average for the past fifty years.

The Senator from Michigan told us that purse-seine fishing began in 1873. Twelve years after it the catch was the largest that had been made within fifty years. Certainly this purse-seine fishing has not diminished the supply of mackerel very much in the high seas during the thirteen or fourteen years it has been in operation. But that does not prove anything positively. The Senator may be right in his prophecy that if purse-seine fishing goes on uninterruptedly for a term of years it will entirely destroy mackerel fishing. My only answer to that is that if it is true he should have brought in another kind of bill, a bill forbidding purse-seine fishing at all. That he has not done.

Professor Baird says further:

It is not impossible, however, that the continuance of the use of the great purse seines may in time have an appreciable effect in decreasing their numbers. The statistics of the next few years will doubtless enable us to form a definite opinion upon this question.

Would it not be wise to postpone the operations of this bill, not for one year, but for five or ten years, in order that we may get some statistics to show whether it is decreasing it or not? Only three years ago, perhaps four years ago—the Senator from New Jersey will know—the persons engaged in menhaden fishing, a fish which is taken only for oil and fertilizing purposes, came here and demanded an investigation by this body, and asked that we pass laws curtailing menhaden fishing, if not to entirely suspend it for a term of years, upon the ground that the menhaden were entirely disappearing from our coast, and that a great industry was being destroyed. While that investigation was going on, while this body was considering the proposition as to whether it would limit menhaden fishing or not, the menhaden fishing fleet, which was out looking after its freight, was struck by the greatest school of menhaden that had ever been known off our coast, made the largest catch it had ever made, and made the largest profits it had ever made. And then what? Those wise men, who had been demanding of Congress that it should stop that kind of fishing, came here and humbly prayed us that we would quit our investigation and not pass any legislation. That is what resulted that year.

Here I show you that in 1885 the largest catch of mackerel was made that had been made in fifty years, and still gentlemen come here demanding that we shall yard up the Atlantic Ocean and prevent mackerel fishing for three months of the year.

Mr. President, I might go on and read the rest of Professor Baird's letter, but I will not encumber the Record with it nor detain the Senate by taking the time to read it. I simply wanted to call attention to that one sentence in which Professor Baird says that he is satisfied the abundance of mackerel has never in any way been affected by man. I infer that it never can be, and I do not believe that it ever will be.

Now, Mr. President, as to the wisdom of Congress undertaking to control this matter by legislation, undertaking to say that our people shall not go out upon the high seas and bring in the treasures of the deep for the use of our citizens, it certainly is a very peculiar kind of legislation. Whether or not it is an infringement of the old doctrine of State rights, I do not know. Whether we can say to the people in the Carolinas that during March, April, and May they shall not go off their shores to catch any fish, or if they do they must eat them on the high seas, they shall not land them in any port, I leave for the constitutional lawyers from that portion of the country to decide. They can say whether that is an infringement of State rights or not. But, as I said at the beginning, it is an anomalous bill. I have been attempting to find out from the chairman of the committee and from other gentlemen who are behind this bill what are the bottom reasons that moved it and that have brought it here. We have had all sorts of reasons given, in my judgment, save the true reason.

Mr. PALMER. I think I gave the reason. I have given it two or three times. This bill is being pushed at the instance of the fishermen of the northeast coast of the United States, who find mackerel fishing unprofitable and find that their vessels and all their equipments have run down to 25 cents on the dollar. That is a sufficient reason.

Mr. MILLER. That may be sufficient for the Senator from Michigan, but that is not sufficient for me. It is no sufficient reason why I should support this bill. It is a pretty plain reason, and I think we are getting to it very closely now.

Mr. PALMER. It is a much better reason than we had for pushing the oleomargarine bill.

Mr. MILLER. All I can say about that is that the Senator from Michigan was my chief lieutenant in that fight, and made the second speech upon it; and he came into this Chamber, getting up off a sick bed to do it, because his people demanded it and because he believed it was right. Has he anything to retract from his action on that bill?

Mr. PALMER. Nothing at all. I merely want to ask the Senator from New York to regard and observe my consistency and go and do likewise.

Mr. MILLER. I am going and doing likewise, but I am not here to legislate, as I said a moment ago, to put a wall around the Atlantic Ocean and to prevent American citizens from going out into the briny deep and fishing and bringing to our shores their fish and selling them to us at any price they can get. If fish are scarce, the price is high. If 60,000 barrels come in, the price goes down to almost nothing, and our people are benefited by it.

No, Mr. President, I think the chairman has finally, perhaps, given us the chief reason why this bill is brought here. A few men engaged in the packing of salt mackerel in Massachusetts and Maine are finding that the catch is so enormous that the prices are going down, not only upon mackerel but upon all other sea fish, and it will not do; their profits will disappear, the people will get cheap food, and these men will not get so rich. If that is a good reason for passing the bill, let those who believe in it vote for it.

Mr. GRAY. Mr. President, I do not discover anything in this bill that is, in the language of the Senator from New York, at all anomalous; nor do I believe that the committee that reported the bill, of which I happen to be one, have laid themselves open at all, in their investigation of the subject and in their presentation of this bill with their approval, to the strictures of the Senator from New York that they have presented in its support "every reason except the true one"; or that by advocating this bill they are in favor of monopoly, or are advocating this bill in the interest of any particular class of the citizens of this country.

They may be mistaken, of course, as to the grounds upon which they urge the bill. They may have not got at exactly the truth in regard to the mysterious ways and habits of the fish that swarm the Atlantic Ocean. There was a great deal of testimony on that subject taken before the committee and very patiently listened to, and digested in this report; but whatever the results arrived at by the committee, I am very sure that the object aimed at was an honest one, and that object was to preserve, not for any particular class, not in the interests of any monopoly, but for the great mass of the people of this country, a cheap food product. Certainly it is worthy of the experiment that we should endeavor, in the light of the testimony that is presented in this report of the committee, to seek some way, some mode by which the diminution of the quantity and the degradation of the quality of this most important food product may be stopped.

It is with that view, and that view alone, notwithstanding the insinuation of the Senator from New York, that this bill is reported back from the committee with a recommendation that it pass with the amendments proposed.

Mr. MILLER. The Senator states that this bill is brought in here because of the great diminution of the quantity of mackerel. I fail to find any such proof in the testimony submitted by the committee. On the contrary, I have read here from Professor Baird a statement showing that the catch of 1885 was the largest of any year for fifty years back.

Mr. GRAY. The evidence taken by this committee and before us to-day shows, if it shows anything, that notwithstanding the improved methods by which fish are taken, notwithstanding the use of purse seines, by which whole schools of fish are taken at one time by a fleet, the catch of fish has not increased in anything like the proportion in which the means of catching them have been improved, but on the contrary there is——

Mr. MILLER. I ask for a reference to the statement showing that the number of fish or the amount of fish caught has decreased.

Mr. GRAY. If the Senator will read the report and if other Senators will read the report—I have not time to refer to it now—he will find and they will find that the proportion of the fish caught is in no wise equal to the improved method of catching them. That is what I mean to say. I do not mean to say that there is an enormous disparity between the actual catch now and the actual catch some twenty or twenty-five years ago; but there has been an enormous improvement in the method of catching these fish, by which, instead of the old hook-and-line methods, they take in a whole school of fish at once, and the degradation in the quality of the fish is established beyond all peradventure, so that the quantity of No. 1 mackerel taken by these fleets ran down from 20, 30, and as high as 35 per cent to 7 per cent, 8 per cent, and 9 per cent in the last three or four years.

But, Mr. President, is it not worth while, even if this be a doubtful question, even if there is a difference of opinion—and I admit that there is such a difference among those who are experts in this matter of fishing as to whether anything that man can do can diminish the supply of fish in the Atlantic Ocean—in the face of this difference of opinion, is it not worth while to make the experiment for five years as to whether a close season, during the period of spawning and up to the time in the summer when the fish drop their spawn, will not improve the quality and conserve for the great consuming masses of this country this most important food product of our Atlantic coast? For, after all, as I said before, that is the object which this committee have had in view all along in their investigation of this subject and in their approval of this House bill.

I said there was nothing anomalous in this sort of legislation. We are constantly upon the land endeavoring to conserve and protect from destruction the great food supply of the forests and the streams. Our State statute books are full of enactments that tend to restrict the natural liberty of man in the taking of fish and in the killing of game, in order that the supply may not be recklessly and wantonly destroyed; and it is upon that principle that I am in favor of this bill; and it is upon that principle, as I understand, that this committee have reported this bill favorably that they may, in the interests of all, endeavor, by the restriction of a few, to preserve a great food supply for the masses of our countrymen.

We heard very fully the constituents of the Senator from New York, who represents a very small portion of this country of ours after all. We heard very fully those gentlemen describe how their interests would be affected by this restriction—I mean the fishmongers of the city of New York. If there is any private interest being advocated upon this floor, as the Senator from New York seems to insinuate, it appears to me it is the interest of those fish merchants in the city of New York and the other large cities of the Atlantic coast that were being advocated by him when he opposed this bill.

Now, sir, special interests must give way. The honest industry of these fishmongers must be subordinated, I submit, to the interests of the great consuming masses of this country. And if this experiment should turn out to be a failure, I do not think that the price we have had to pay for it will be a very costly one. It is only for five years. I believe that the experiment will result advantageously. I believe that it will vindicate itself and that the restriction of fishing on the Atlantic coast will have the same effect that restrictions upon fishing in our streams in the States by the State legislatures have had in improving the quality and the quantity of the fish supply to the country at large. It is for this reason that I am willing to vote for this bill, and believe that it ought to pass.

Mr. MILLER. Mr. President, as I have shown conclusively from the evidence taken before this committee, the amount of mackerel in barrels, the catch has never been so great as it has been since purse-seine fishing began, and, as Professor Baird says in his letter, the catch in 1885 was greater than

that for any one of the fifty years previous. Quite likely the quantity of No. 1 mackerel taken may be less proportionately, because by purse seining all the fish are taken, large and small; but when these enormous percentages were given by the Senator from Massachusetts, showing that 50 or 60 per cent of the catch was No. 1, you will find if you go over the tables that in those days when there was no fishing except with hook and line the number of barrels taken was a mere bagatelle in comparison to the number taken at present.

In 1809 there were only 8,000 barrels taken. In 1814, when we were not permitted to go upon the high seas because a foreign power kept us off, we took 1,300 barrels; in 1819, only 4,300; in 1839, only 74,000 barrels; and so on down. But, as I have shown, in the year 1884 we took 283,000 barrels, or rather that amount was inspected in Massachusetts alone, and last year the amount was 215,000.

The Senator from Delaware [Mr. Gray] has been kind enough to suggest that I am opposing this bill in the interest of the fishmongers of New York City and other Atlantic coast cities. Well, Mr. President, I accept that designation. The Senator in his tone of voice and his manner undertakes to imply that fishmongering or selling fish to the people of this country to eat is not a very reputable business. I do not hesitate to stand here and represent those men, and represent all their customers, which means all the people of this country who eat fish and who can not afford to buy No. 1 mackerel. That is what I stand here for.

Then the Senator asks us to make an experiment for five years; to stop this fishing for three months in the year, for five years, for fear that something may happen. Why, the last day may come before that time, and this whole earth may be rolled away, for aught I know. Many of us have no interest in who shall eat fish five years from now.

I undertake to say that in this testimony and in the testimony of the highest scientific authorities in the world there is not a scintilla of proof to show that man, by all his appliances in modern fishing, has done anything whatever to diminish the supply of fish in the sea. Why, then, shut our people out from the seas? Here is this food, free to us all. Thousands, four, five, six, or ten thousand men are engaged in this industry, and they are bringing food to our people and supplying their wants. Because we find that the interest paid upon the investment in the ships and the interest paid to the fish houses in Massachusetts and Maine in packing salt mackerel was larger when the catch was only 50,000 barrels than it is when the catch is 280,000 barrels per year, are we to say to our people, "You shall not have 280,000 barrels of mackerel; you shall only have 50,000 barrels, and you shall not eat anything but No. 1 mackerel?" Are we here to legislate in that way?

Mr. President, there is no similarity between this proposed law and the game laws which we pass in our several States to control the taking of fish in our inland waters. We all know that in our interior small lakes and rivers it is possible for our large population, if not controlled by law, to take out all the fish that may be found in a certain stream, or pond, or lake; but here we have the testimony, as I said before, of the best scientific authority in the world, saying that up to the present time man has done nothing to diminish the number of fish in the sea.

But the Senator from Michigan and the Senator from Delaware, who are doubtless very fond of good fish upon their tables, have a fear that if we do not stop this purse-seine fishing for three months in the year all the good fish will disappear. Without any testimony, without any proof from any reputable source whatever that that will be the effect, we are asked to shut up the Atlantic Ocean, to say to our people that they shall not catch fish there, or if they do catch fish there that they shall not bring them to our shores.

Mr. President, I thank the Lord that I am not a constitutional lawyer. I am not disposed to go into the constitutional question and to consider whether we have the power to do this thing or not. I am surprised to find that any of our free-trade friends on the other side of the Chamber are willing to go beyond the men on this side in shutting up our ports to anything. You can catch all the mackerel you choose to catch offshore with a hook and line; that is a home industry; but if you go outside the shore, if you go out into the open sea, and take fish during three months in the year, you shall not land them here at all! Would not Senators be satisfied with a duty of 50 or 100 per cent on fish caught beyond the shore line during those three months? Would they go so far as to make protection absolute by making it prohibition?

Mr. Palmer. Does the Senator mean to convey the idea that fish caught with a hook and line outside of the three-mile limit can not, under this bill, be brought into the country? The Senator seems to be confused on that. I wish he would read the bill over in the next interval he has.

Mr. Miller. I have read it so many times that I really do not want to do it again and take up the time of the Senate, but if that is what the Senator from Michigan means, if this is for the

protection of a home industry against a foreign article, if he puts it on that basis, perhaps I might support the bill. I am trying to find some proper ground on which we can support the measure. I am surprised that the Senator from Delaware should support a measure which will absolutely close our ports to one of the chief products of the world in the way of food.

Mr. GRAY. I am in favor of cheap food, whether it be fish from the sea or other food product, and I think I have made my position clear enough, perhaps, if my position is of any importance at all, that my advocacy of this bill and my reason for voting for it is that a cheap food product may be conserved for all the people of this country. I may be mistaken in the mode which I believe now will be efficient to that end, and the committee may be mistaken; but the committee has presented to the Senate this House bill with the evidence which has been taken in support of it, and asked the Senate to read that evidence and to take that bill, and for a period of five years to make the experiment whether we can not, in the interest of the mass of the people of this country, preserve for them a food product which we have reason to think is rapidly diminishing in quantity and being degraded in quality.

Mr. GEORGE. Has there been any proof in the case that there is a sensible decline in the supply of mackerel?

Mr. GRAY. I think so. I think the evidence taken before the committee tended to show most unmistakably that there was a very serious decline in the quantity of mackerel taken when you consider the improved appliances now used for catching the fish and, what was more important, and has already been insisted on by the chairman of the committee, I think with great force, that the degradation in quality has been more serious still, and though the number of fish taken may not be so very much less now than it was some years ago, yet if you take them pound for pound instead of per capita the diminution in quantity will prove very great.

I do not wish to occupy the attention of the Senate again, except to say, what perhaps is plain enough, that, so far as the fishmongers of New York or of any other part of the country are concerned, I think their employment is quite as respectable as that of the Senator from New York or of myself. Anything that I said had nothing to do with the respectability of that calling. I merely contrasted the smallness of their interest in this question with the magnitude of the interest of the great consuming masses of the country, and that was all that I intended to say, and all that I think I did say.

I wish to say one other thing, because it interests the people of my own State, and I think interests the people of the States from Carolina up to the southern line of Massachusetts. The interests or prejudices, or whatever you may choose to call them, of the Senators from those States have been appealed to because the close season that is proposed by this bill is about the time that the fish are found upon the coast from Carolina up to the southern line of Massachusetts. That is about true, but it should be recollected that the boats and the men who take those fish are, after all, the same "Yankee fishermen" that the Senator from New York speaks about. Those great fleets from Gloucester and from Maine sail down the coast in the beginning of the spring to meet these fish off the coast of North Carolina, and follow them all the way up to Massachusetts. So that the fishermen who are principally interested are these same "Yankee fishermen," and it is they whom this bill will principally restrain, because there is an amendment in this bill, as brought from the committee, which provides that its restrictions shall not apply to mackerel taken by hook and line in boats of any size in the old-fashioned way.

Mr. GEORGE. I desire to ask the Senator another question. Is the Senator to be understood as admitting that this practically prohibits fishing at any time in any waters for mackerel?

Mr. GRAY. I am not able to say, in answer to the question of the Senator from Mississippi, whether it entirely prohibits it or not, or whether at any other time in the year those fish are on that coast. I am inclined to think that is true, so far as mackerel are concerned. But what I do mean to say is that the mackerel catch is made in those months when they are on these southern coasts by the very same fishermen that make them in the other seasons of the year. I mean fishermen from Maine and Massachusetts.

So, Mr. President, the people and the fishermen who are particularly affected by this bill are those who live in New England and not those who live upon what we may call our southern coast, for they are fairly protected, as I said, by the amendment of the committee which allows the catching of mackerel by hook and line in boats of any size.

I therefore think that all appeals made by the Senator from New York to the interests, the supposed selfish interests, of the States of North Carolina, Virginia, Maryland, Delaware, and New Jersey fall to the ground as utterly without foundation.

Mr. MILLER. I have made no appeal to the selfish interests of the people of Virginia or the Carolinas. There is nothing in my remarks that warrants the Senator from Delaware in making any such statement here. I do not propose to let that statement go unchallenged.

Mr. HALE. Mr. President, I can see that when a bill of this kind is presented, which apparently interferes with what has been a recognized liberty for years, fishing in the broad Atlantic, Senators may hesitate in giving it their support unless clear and indisputable reasons are submitted for the passage of the bill.

It is not right that it should be presented to the Senate as a bill in the interest of a monopoly and that the opposition to the bill is in the interest of the great public. Precisely the reverse is true. This bill seeks to perpetuate for the people of the United States a great food supply, not for two or three months, but for the entire year. For years the supply of mackerel to the people of the United States, consumed upon their tables throughout the land, has been a considerable part of the everyday consumption of the people. It does not rest with the consumption in March and April and May, but it is a product that is found upon the tables of the people all through the year, and the greater part of the product and the desirable part is the great catch late in the year.

The Senator from New York says that this is a New England measure; that it is simply to help a few Yankee fishermen. Why, sir, the bill was reported in the other House from the Committee on Ways and Means that has but a single member from New England upon it. It was championed there and explained by a member from the State of Arkansas, a member of the illustrious Breckinridge family of Kentucky, who went over the whole provisions of the bill, showing clearly that it was a measure so much in the interest of the people that the House passed it overwhelmingly. It is reported here in this body from a committee that has but one member from New England upon it, the chairman living in Michigan, having no interest whatever in these fisheries.

And, Mr. President, this bill is not opposed by, and the Senator from New York in his opposition does not represent, a fisherman in the United States. There is not a fisherman on the coast of North Carolina, or New Jersey, or Virginia, or Maryland, or New York, or Delaware who opposes this bill. The bill has scrupulously guarded the interests of every fisherman everywhere. There is not a man who goes out from the coasts of the Southern States fishing for these fish, as he has done for years in his boats, or with traps, or with seines, that is not allowed to go on and do as he has done in the past. There is not a man along the coast of the Middle States that is touched; but his rights are, on the contrary, preserved; nor is there a man in New York or anywhere else affected. The only men—and that has not appeared in the discussion yet except as alluded to by the Senator from Delaware—the only men who are restricted in this case are the New England fishermen who go from Massachusetts and Maine.

Why, sir, every one of these fish that are caught in the months of March, April, and early May and landed, dumped in quantities that can not be consumed into the markets of New York, is caught by these same New England fishermen. The same vessels that are engaged and the same men that catch these fish, taken when they are good to supply the great markets of the country, are the vessels and the men that catch these fish in March and April and May and land them in New York. It is only a restriction upon these men that this bill imposes, and that restriction is imposed upon them because it has been found that their manner of fishing in these months destroys the great good of the mackerel fishery, which is in August, September, October, and November.

Scientific men (as Huxley has discovered, as Professor Baird has discovered, as Professor Collins, who Professor Baird says is the most expert man in all these subjects, has discovered) may discuss as to what the habits of the mackerel may be and their migration, and what effect the coming upon them in spawning time may have, and they may disagree; but one patent fact is that with the immense demand for mackerel, ten times as great as it was fifteen years ago, with the appliances for catching by purse-seines, so that they can catch a thousand where they formerly caught ten, still there is not an increase commensurate with these facilities and with this demand; and all we have been able to do is to barely keep up the supply, or in some abnormal year perhaps increase it. But one fact is plain, and that is, where you take these schools of fish at a time just before the spawning season and you let this fleet of New England fishermen drive into them, as they do, with their purse-seines, landing them by thousands and tens of thousands, whether you diminish the quantity perceptibly or not, you do disturb the migration of the fish; you drive them into the outer waters; you drive them, as Professor Collins (who is indorsed by Professor Baird as the most expert man on all these subjects) says, undoubtedly into other feeding-grounds, and the result is that when you come to the good part of the mackerel fishery in which the people of the United States are interested, not the Maine and

Massachusetts fishermen alone, then you have got no such product from the fishery as you had years ago, and therefore the fishermen themselves ought to be restricted.

Mr. President, there is only one interest that is opposing this bill. I say again that not a fisherman opposes it, not one upon any coast; they are all cared for. But in March and in April, when this great fleet drives into the schools of fish and lands 60,000 barrels in New York, which can not take care of 30,000, it may be a part of which are consumed, then the fishmonger, who is at the bottom of the opposition to this bill, comes in and buys. I have statistics here, which if necessary I will put in before the debate closes. He buys the fish at a cent and a half per pound. The men who are engaged in fishing, who work on these vessels that catch them, do not average $6 a month for their pay; but the fishmongers in New York—three or four there hold control of the market—buy these fish at a nominal rate and retail them out, poor as they are, at 8, 10, 12, and 15 cents per pound, and make that enormous profit, and they form the whole opposition to this bill. I know how it was before the committee. The whole voice that was expressed against it there was expressed by the fishmongers and the men they sent down from New York. It is an attempt to stand in the way of legislation which Congress has adopted for years, which every State has adopted, of having a close time in order to protect the food products.

There never was a time when you attempted in a State to fence round, as the Senator from New York says (using that phrase to prejudice this bill), there never was a time in a State when it was attempted to fence round a lake, or the water of a river, or any water under the jurisdiction of a State, that it was not said that it was interfering with the liberty of the citizen, and undoubtedly that raises prejudice; and unless it be shown that it is for the good of the people afterwards in protecting the supply of food, the citizen ought not to be restrained in his liberty. If anything has been shown, that has been shown here.

I repeat that the opposition here comes right from the center of New York City, where these fishmongers are. Let anybody examine the document that the Committee on Fisheries has presented to this body, which the chairman holds in his hand, and which every member can get, and he will find that the inspiration of the opposition comes from there and there alone. I for one will not sit here and allow this wise measure to be prejudiced by being placed before the Senate in a wrong manner.

More than one Senator has asked me, "Does not this prohibit the catching of all these fish until they get up to the shore of Maine?" No, sir; not in the least. That is not the theory of it. The Maine fishermen, as I have said, catch these fish at all times, whether good or not, and every fisherman that comes out from the coast below New England is jealously guarded in the provisions of this bill. He will go out and fish and he will catch the larger fish, because in fishing by boat and seine he will get those fish and they will be brought into the market, and Philadelphia and Baltimore and Wilmington and New York and Hartford and the cities along the Sound will get them under these provisions.

Mr. MILLER. The Senator has said that this bill does not prohibit the catching of fish until they reach the coast of Maine or Massachusetts. What does the bill do? I would like to have the Senator tell us.

Mr. HALE. The bill leaves all the fishing that the local coasts are engaged in unmolested and protected and guarded. It then provides that at this period when the fish are poor, approaching the spawning season, then outside of our waters (not raising the question of what can be done in the State waters, but dealing with goods imported into the United States as we may deal with any imported product), for the months when the fish are in that condition they shall not be caught. The reasons for this I do not need to repeat, because by so catching them you destroy the great portion of the mackerel fishery, which is the portion that comes later in the year and in which the people of the United States are interested everywhere. The people of New York City and the little neighborhoods around there are interested in the fresh fish that are brought in in those months in great quantities, but the people of the United States are interested, Kansas is interested, Nebraska is interested, Michigan is interested, Iowa is interested in this great food product that is caught later, that is salted, and then finds its way to the table of everybody, and it is the interest of everybody that that should be kept up.

The Senator from New York says it is not everybody that eats No. 1 mackerel. No, sir; but when you destroy the catch of fish that are now produced and that make the supply of No. 1 mackerel small, you bring back the old price at which No. 1 mackerel was put on the table of the inhabitant of Michigan years ago; you apply that same price to No. 1 mackerel which is now paid for No. 3 by

the people of the center, the interior, of this country, who are eating fish as they always will when they can as a relief to their internal products. They are paying the prices they ought to pay for No. 1 mackerel, under that well-guarded system of fish preservation, for No. 2 and No. 3.

The fish that are brought into New York, that the Senator says so much about, are a cheap product; they are a poor fish. I know how poor they are, and everybody who has had any comparison knows how poor the fish is that is put on your table at the Brunswick or the Fifth Avenue Hotel, or any other hotel there in the months of March and April, not fit to be eaten compared with the fish that is caught at another time after the spawning season has passed, and when it has become fat. No man who has partaken of the one will buy the other, notwithstanding the enormous rates and notwithstanding the enormous profit that the New York fishmonger gets.

I did not mean, for one, that the debate should close without the true attitude of this matter being presented to the Senate. It is a thing in which everybody is interested, Mr. President. It is a restriction upon New England fishermen. It cuts off the work of Massachusetts and Maine fishermen, and is a restriction upon them to which they submit because, as I have said, great gain will come in the increased value of the fish product later in the year.

Mr. SEWELL. Mr. President, to remove the impression created by the chairman of the committee as to this being a unanimous report of the committee, I beg to say that as a member of the committee I dissented from this report entirely.

Mr. PALMER. I will say in explanation that all the members who were present agreed to it, and I supposed that we had a full meeting. The gentleman did not put in an appearance, I think, at the time of the investigation.

Mr. SEWELL. Perhaps not; but I find my name mentioned in the report of the committee on almost every page as having questioned the witnesses.

Mr. PALMER. That must have been the fault of the stenographer, and not of the chairman.

Mr. SEWELL. I tried for several years to stop what is occurring to-day, the destruction of food-fishes within the three-mile limits on the shores of the Atlantic by what is known as menhaden fishing. I was met in the committee and by the gentlemen engaged in this fishing—who have their capital invested with over one hundred steamers that occupy the entire coast line of New Jersey during the summer time—with the statement, backed up by the evidence of Professor Baird and Professor Huxley, that man has never been able, up to this time, to decrease the product of fish on the broad seas.

The menhaden come along our coast the same as the mackerel do, only closer inshore, and they are taken, converted into oil and fertilizers, and they damage the food-fishes in that sense that dragging a purse-net so close in to shore, almost at the mouth of our inlets where the ordinary bluefish go to spawn, destroys the beds for the feeding of the bluefish. But the majority of the committee became satisfied that nothing man could do would decrease the product of fish, and no action was taken.

The mackerel strike Hatteras about the time that the menhaden do, and they follow the shores to the northward, arriving at the northern part of Massachusetts and Maine about the 15th of May or the 1st of June.

The object of this bill is to give time for the mackerel to fatten. The great fishing fleets owned in Massachusetts and in Maine have found it unprofitable to carry on what they have been doing for years since the invention of the purse-seine and its substitution for the hook and line, going to the southward and meeting the mackerel off Hatteras; and the whole intent, or if not the intent the absolute result, of the bill if passed will be to fatten up all the mackerel of the Atlantic Ocean, following the line from Hatteras northward until it arrives at the coast of Maine, where the Maine fleet will be ready to take advantage and catch them all. It is legislating for a monopoly of the very worst kind to the exclusion of the natural rights of the people of the Carolinas, Virginia, Maryland, New Jersey, and New York, prohibiting us from taking advantage of the passage of that school of fish during three months of the year.

Mr. HALE. Let me ask the Senator if he knows of a single craft of the State of New Jersey or of either of the Carolinas or Maryland that is equipped for catching this early catch of fish with modern appliances?

Mr. SEWELL. I merely state from the testimony in the report of the committee that there were seventy-five vessels engaged in bringing mackerel, during the three months in which you endeavor, to prohibit it, into the port of New York. It is not a question with me where they come from.

Mr. HALE. Does the Senator know of a single vessel in his own State that is engaged in it?

Mr. SEWELL. I do not.

Mr. HALE. Does he not know of hundreds and thousands of coast fishermen who catch these fish in boats and take them into a market who are beneficially affected by this bill, and who will catch the big fish that ought to be taken into market because they catch with seines and get the big fish.

Mr. SEWELL. It is a time of the year when fish are scarce practically, when fish command a good price. It is a time of the year when people ought not to be prohibited from their natural right simply because you want to gobble the whole catch.

Mr. President, as I said, the result will be that our friends in Massachusetts and Maine, with their usual foresight, will be enabled to take the fish in the best condition, I grant, but will take all of them to the exclusion of the inhabitants of the United States south of that line. It is a monopoly and a monopoly of the worst kind, one that legislation of the United States has never gone into up to this time, to exclude any part of its citizens from the natural right to fish on the high seas.

Mr. PALMER. There seem to be some very queer and diverse views entertained in regard to this bill. One gets up and claims that it is a monopoly. The fact is that the men who are claimed to be seeking possession of a monopoly have it now, and I should call it a bill as much for the protection of the fishermen of New Jersey and Delaware as for the protection of the fishermen of the New England coast. This whole mackerel fleet that uses purse seines is owned upon the New England coast. The bill is a guarantee that each member of their fraternity will observe the obligation that they all profess to be willing to enter into—to not destroy the fish by harassing the schools as they come to this coast.

We have not claimed, in the pushing of this bill, that the catch of mackerel was decreasing, but taking this table from the mackerel chart, showing the Massachusetts catch for the past seventy-five years, you will find that it has positively decreased, notwithstanding the immense advantages by the purse seine and the immensely increased demand by the methods of distribution through the railroads and steamboats and the refrigerator cars throughout the country.

Mr. MILLER. I know the Senator does not wish to convey a false impression in regard to this matter. He is altogether too fair to do that. The table he is reading from says this is the "total number of barrels of each quality of pickled mackerel inspected in Massachusetts from 1809 to 1885 and the total value of each year's inspection from 1830 to 1885."

Those gentlemen who are telling the Senate that, notwithstanding the wonderfully improved methods of fishing, the catch has not increased, certainly are making a misleading statement, because this table has nothing whatever to do with the mackerel that is brought into the port of New York or into any of the Atlantic ports which are consumed as fresh fish. In fact nearly the entire catch of the three months of March, April, and May are thus consumed. They are not salted. Some of the testimony given here in this book undertakes to show that the catch in these three months is not salted at all; that it is all distributed over the country as fresh fish. Certainly the Senator will not undertake to base his statement upon that table, because it leaves out all the catch of the three months which is distributed over the country as fresh fish. For instance, in the year 1885, when 60,000 barrels were brought into New York in one day, that table shows nothing of it at all!

Mr. PALMER. If the Senator will permit me, I will state that the only means we have of coming to a conclusion as to the relative catch of mackerel is by this table prepared by the Boston Fish Bureau, and there it is shown that in 1831, with the hook and line, 383,000 barrels of fish were caught; but at no time since then has any such quantity been caught by the fishermen of Massachusetts.

Mr. MILLER. That does not answer my question at all.

Mr. PALMER. I was going to qualify my remark. As a matter of course this does not take into account the amount that has been marketed in New York fresh, nor does it take into account the 100,000 barrels that are thrown overboard to infect the waters and to frighten the schools of mackerel as they come along the shore. And right here I should like to show what is said on that point. Here is a letter from Capt. Joseph Smith, of the schooner *Lizzie M. Center*. He says:

> For the first four or five years the number of vessels engaged early was small.

That is, engaged in purse-seine fishing.

> They did not appear to make much impression on the school, as they were very numerous and large and the vessels did not start before May, but the last eight or nine years the fleet has increased so very much, and starting, say, in March, meeting the mackerel off the coast of Virginia, and at times farther south, while they are moving north to their spawning grounds, harass and annoy them by their seines and by sailing through the schools frighten the fish, breaking them up and turning the fish offshore in deep water, on the very edge of soundings, and the result, they shun our bays and small banks, where they formerly resorted to deposit their spawn, and pass along to the south of Georges Banks, and striking the southern coast of Nova Scotia, deposit their spawn among its numerous islands and bays, where they have not been molested to any extent in the early part of the season.

I could go on and read much more of that, but I will not take the time of the Senate.

Now from the same letter:

Also, to give you an idea how sensitive large mackerel are and how easily frightened and driven from their grounds, I have often seen large bodies of mackerel, when first coming upon them, anywhere from one to fifty schools at one time may be seen from the masthead, the fleet would in a few hours break up and drive from sight the whole body of fish. They would not be seen on that ground for days after, and probably not again during the season. Again, vessels sailing along leave a narrow strip of boiling and foaming water after them for many minutes. We sailors call it the wake.

He claims that wake in itself, being made through the schools of mackerel, frightens them off.

This is from Mr. H. S. Fisher, of New York:

The mackerel caught south early in the season are the poorest fish known to the trade, as you and all other dealers know. They are sold fresh, mostly in this market, and controlled by three or four fresh-fish dealers. When the market is overstocked, if the fish are sound, they are split and salted. The largest receipts of fresh mackerel ever known here was in the month of April, 1885, and a large part of them were in very poor condition. The good—that is, the sound ones—brought fair prices, but the poor—soft and broken—were sold for any price they could get, even as low as 25 cents a cart load.

They are called cheap food for the people. I think all such food should be condemned. They lay there by millions on the docks and were carried away in that promiscuous manner.

Here is a letter from J. C. Young, agent of Commercial Wharf Company, Wellfleet, Mass.:

But now, since the vessels go out so early, say the middle of March, they find the mackerel, break up the schools, drive them from their old spawning grounds, and when caught, put on the market a poor and sickly quality of fish, that is ruinous both to the consumer and producer, and is ruining the whole business, as you well know.

Mr. MILLER. This wonderful witness seems to have found mackerel on the spawning ground.

This particular one seems to have found them on the spawning ground in the middle of March. What becomes of the theory that they go up the coast of Maine, and perhaps to the Bay of Fundy, and do not spawn till June or July? The witness and the committee disagree on this question. Here the man finds the spawning ground away down south in the middle of March, and says they are frightened away.

Mr. PALMER. I do not know how many explanations I shall have to make to the Senator from New York to give him a clear insight into this mackerel migration. I will say now, and I hope it will be for the last time, that they appear in March off Cape Hatteras; they keep up along the shore harassed and annoyed by those sail vessels till the first of July, when they commence to deposit their spawn. The gentleman seems to be a little confused as to what the spawning season is. He thinks it is the last climax of that effort of nature. It is the whole gestative period from the first of March to the first or last of July, and if he will take into consideration that that time includes about four months, it will save me or other gentlemen a great deal of confusion hereafter in answering any objection.

Mr. MILLER. The Senator could have saved himself and myself a great deal of trouble if he had drawn this bill so as to cover that period of four or five months.

Mr. PALMER. Is that clear?

Mr. MILLER. Not yet. The first question I asked was, If this wonderful witness found these fish on the spawning beds, as he tells us, on the first of March, and if the Senator tells us they do not spawn until July, must they carry the spawning bed with them? I think so.

Mr. PALMER. I think I have made it clear that the spawning season is from the first of March to the last of July. What was the other question the Senator asked?

Mr. MILLER. I hope the reporter will get this scientific discussion carefully down, because if the spawning period of mackerel is extended from the first of March to the middle of July the scientific world will be surprised, and they will want to have this discussion very carefully reported.

Mr. PALMER. It is getting late and I hope the gentleman will not interrupt any further except as to some point that he has not been informed on. We have here any number of letters and any amount of testimony in regard to the numbers of mackerel thrown away every year. None make it less than 75,000 barrels.

The Senator from New Jersey [Mr McPherson] spoke of some professor on the coast of Scotland who had given his time and efforts to the herring fishery, to determine whether anything man could do could deplete the ocean. I will say that Professor Huxley, if he is the gentleman to whom the Senator refers, does say that nothing man can do in the way of the spoliation of the sea of fish will amount to anything, but Professor Huxley had never seen a purse seine.

In the testimony before the committee I asked Mr. Blackford, a very intelligent gentleman, the fish commissioner of New York, if the methods were as destructive in the herring fishery, and he said

he thought they were. I asked if they had purse seines. He said he thought not. I do not believe that the purse seine is used on the British coast; but I think it is fairly deducible from the tables and from the percentages, as shown by the Boston Fish Bureau, that the tendency of the use of these purse seines is to break up the schools, frighten the older and wiser fish, the No. 1 mackerel, outside of their ordinary routes, and drive them off onto the banks of Nova Scotia. It is fair to infer that fish have intelligence. The Senator from New York [Mr. Miller] is too good a sportsman to contend that they have not. They have sufficient, enough to protect themselves, of that instinct of self-preservation.

And right here, it appears in the evidence that codfish on the Banks will go off at the fall of a single barrel on the deck, will sometimes disappear and be gone for a whole day, that the fishermen on the Banks take the offal 40 or 50 miles out to sea and throw it overboard, rather than to throw it overboard amid the schools of fish. Here are a hundred thousand barrels of dead fish thrown over to frighten these schools away from their ordinary route.

Now these men come to Congress and ask for this act. I think that they are entitled to consideration. It has always been the policy of the Government to lend a willing ear to any of the complaints of the men who have manned our Navy, of the men who fought with Perry on Lake Erie, with McDonough on Lake Champlain, and with old Commodore Hull on the *Constitution* and on the *United States*, and in all those naval battles that have given our country its prestige upon the ocean.

I ask that this bill with the amendments made by the committee may pass and that this trial may be made. Its operation is being deferred a year or two. If it is going to work any hardship, it can be repealed after there may be a further expression upon the subject.

Mr. FRYE. Mr. President, there is one thing which has been stated here that I wish the Senate to distinctly understand, and that is that there is not one single mackerel-fishing vessel with a seine west and south of Massachusetts—not one. There is not one in New Jersey, or New York, or Pennsylvania, and there is not a fisherman outside of Massachusetts and Maine that has the slightest earthly interest in this bill except as it is intended to preserve the fish. That is a queer monopoly that the Senator from New Jersey and the Senator from New York talk about. Here is a fleet of 200 vessels, every one of them belonging to Massachusetts and Maine, every one of them proposing to make money in the spring fishing, every one of them fitting out to go down to the fishery off Hatteras and go to fishing, and yet, amazing to say, they unite to a man in asking you to pass a bill which shall absolutely prevent them from going down on the coast to fish. Why do they do that? To create a monopoly in their interest; or is it in the interest of the people of the country? Talk about monopoly! There has not been one single man before the Committee on Fisheries, there was not a man before our Committee on Foreign Relations—and we investigated this to a certain extent—who said one single word against the close time of mackerel, except one or two fish-market men; and the fish-market men of New York have had one fish-market man here nearly this whole session of Congress busy to fill the minds of Senators with the idea that this was a monopoly in the interest of Maine and Massachusetts—the Yankees, as the distinguished Senator from New York with good taste said.

Mr. President, what is the fact? The fact is that these mackerel when they come to the coast are as poor as they can be. The fact is that with the mackerel it is just the same as it is with salmon, and trout, and every known fish with known habits—that they eat very little indeed while they are bearing spawn. I hope the Senator from New York has finally got it through his head that spawning time is not the time when they deposit their spawn. These mackerel are bearing spawn from the time they approach the coast in the middle of March up to June, and through June when they deposit their spawn no man can take them with a purse seine, because they are out of sight, they are deep down in the water, and the purse seine only takes them when they are coming up in shoals on top.

It is another fact which I know myself—for I am something of a fisherman—that twenty years ago, before the purse-seines were invented, you could start down on the coast of North Carolina and you could follow these fish away up to the coast of Maine, and there would be dozens and dozens of little boats of 10, 15, 20, and 25 feet keel catching mackerel for market with hook and line. It is a fact to-day that these things are unknown, that these boats have stopped undertaking to fish with hook and line. It is a fact that twenty years ago I have taken mackerel by the score and score right from the wharf with a hook and line, and the whole bay full of them, and now the mackerel in those bays are almost absolutely unknown. It is a fact that all along the bays on this coast used to be full of mackerel and that to-day it is an exceptional thing to take a dozen mackerel in a day's fishing with a boat. What has done it? There is where you were hurting the poor men who want to fish. What has done it? The purse seine.

I say it is a fact, Mr. President, that these poor men are deprived to-day of the rights which used to exist. And why? Because two or three hundred Maine and Massachusetts fishermen, in

vessels from 75 to 150 tons each, armed with two great purse seines that can gather in half an acre of mackerel seen on the top of the water, go down in the middle of March off Cape Hatteras; they put a man at the masthead, and day and night, without any cessation, they pursue these schools of mackerel from the time they come to the shore until they go down into the deep water and drop their spawn.

The mackerel is the most timid fish that swims in the sea—more timid than the trout, even, or the salmon—and this process of taking these fish with the great purse seines by a hundred or two hundred fishermen has not depleted them. Nobody on earth knows whether they are depleted. Professor Baird does not undertake to say whether they are depleted or not; he does not undertake to say whether man can deplete them or not; but they are driven away from the shores and from the fishermen accustomed to fish in boats on the shores. So the evidence before our committee was that the large majority of the mackerel taken were taken from 15 to 20 miles from the shore, where the small boats could not venture and do not venture.

The men interested in the mackerel business believe that if you will put a close time on mackerel, run it up to the 1st of June, when they begin to spawn and go to the bottom and out of the way of the purse seines, your catch of mackerel will come back to its usual haunts and that the people from North Carolina up to the State of Maine can go back to the old way of fishing, where they can go out in their little boats and catch from 100 to 500 mackerel in a day and take them ashore and get their pay and have them in the market all up and down.

What is the operation now? These great fleets of vessels go down into the southern waters. They have an immense draft of fish, and they hie away as quickly as they can to the port of New York in order to land them before they spoil. Then they are landed in the great city of New York by millions, and, as the Senator from New York said, they are sold to the fish dealers for 1 cent apiece or 10 cents for twenty-five, and in one single year 35,000 barrels were thrown overboard into the sea as spoiled.

Mr. MILLER. The Senator puts words into my mouth that I did not use; and therefore I do not ask his courtesy to correct it at this time.

Mr. FRYE. I will put it into somebody's mouth. Somebody said it. It is the fact, notwithstanding, that the fishermen were compelled to sell their fish for a cent apiece to the fishmongers of New York City or twenty-five for 10 cents. Who was it said that they were sold at 10 cents for twenty-five? The Senator from New York, I think, said it.

Mr. PALMER. No; I said it.

Mr. MILLER. If the Senator will permit me, what I read was the testimony of what the Senator sees fit to call a fishmonger, Hon. Eugene Blackford, of New York, a distinguished citizen of the State of New York, one of our fish commissioners, as he has been for years.

Mr. FRYE. He sells fish, does he not?

Mr. HALE. I understand him to be the principal fish dealer in Fulton Market.

Mr. MILLER. In his own testimony before your committee, which I read here, he said the price at which they were sold was the price at which they were sold by the dealers, not by the fishermen themselves. They were handled by the dealers, the whole of them.

Mr. FRYE. And that same year 30,000 barrels of them were thrown away as absolutely useless. Every year, when sudden luck comes to these fishermen, and they are obliged to hasten to port to get rid of their drafts of mackerel, half of them sometimes are thrown away and wasted.

The trouble is that our fishermen are frightening the mackerel away from their haunts and that the fishermen on the shores can not get the chance to take one a day with hook and line.

Mr. GRAY. Their rights are saved in the bill by an amendment which has been adopted.

Mr. FRYE. The Senator from Delaware calls my attention to the fact that all the old-fashioned fishing is saved by an amendment to the bill.

There is another thing to which I wish to call attention. The Senator from New York says this is a very strange bill; that if the scientists and learned men in fish want to protect the mackerel, why do they allow nets and seines on the shore? It ought to be obvious to a man who knows anything about fishing what it is allowed for. The bill absolutely permits the landing of mackerel during the specified length of time all up and down this coast from seines and nets attached to the shore. What for? To take mackerel? Not at all. They are not placed there to take mackerel. They are placed there to take the other spring fish which come upon the shore, but there will be mackerel that will get into the nets and into the weirs, and we do not wish to compel those fishermen with nets and weirs to throw away mackerel and waste them and make them useless. We were protecting the rights of those poor men on shore, so that if a few mackerel did get into their nets and weirs they could sell

them and not be compelled to destroy them. There can be no objection to that. That was suggested by Professor Baird himself, the greatest scientist in fishing there is in this country.

Mr. President, it is an experiment worth trying to see whether, if you will prevent these fishermen from Maine and Massachusetts from pursuing these methods, the mackerel will not come back to our shores once more and enable the poor men up and down the coast to reap the harvest they used to reap years ago, before seine fishing was invented. It is an experiment, I admit, but we never shall learn anything or gain anything if we do not make experiments. There is one thing to be observed. Every owner of a fishing vessel who testified in relation to this matter testified that in his opinion the experiment ought to be tried. Every one so testified; there was not an exception.

The Senator from New York says that the poor fishermen will be themselves deprived of work. It is not so. They will not be deprived of work. So careful has the committee been to protect in the bill the rights of the poor men that there is a provision in it which protects the fishermen. What is that? It is a provision extending the time when the bill shall take effect up to 1888, as proposed by the Senator from Massachusetts [Mr. Hoar]. That provision protects the fishermen. I will admit that if the bill went into force to-day it would do harm to fishermen. I admit that all those craft to-day are ready for the ocean and for Hatteras. I admit that their captains and cooks and crews are engaged for a three months' trip to take mackerel, and if the bill took effect to-day they could not change from a mackerel to a cod fisherman in a month's time.

Mr. MILLER. Can they change by next year?

Mr. FRYE. Next year every one of them will have been changed into a cod fisherman during that time. They will then pursue the cod-fishing occupation.

Mr. MILLER. The codfish will all be destroyed.

Mr. FRYE. I will risk the codfish. I have here a bundle of letters from New York, from Boston, and from Maine touching the matter of close time on mackerel, and there is not a man from New York or anywhere else who says in his letter that you ought not to try the experiment, and every one of them, they being men who have fitted out their vessels for the South, simply asks Congress that it will so amend the bill as to have it take effect next year and not this. That is all they ask. What for? That is in order to give the fishermen time to transfer their vessels from mackerel fishermen to cod and halibut fishermen, and to give them time to fit them for that business. It requires a good deal of time. They want to have time to fit their craft for that business, and then these same fishermen will be pursuing that occupation, instead of murdering the mackerel as they are now doing on the coast from Hatteras up.

Mr. MILLER. Notwithstanding the kind reminder of the Senator from Maine that I had occupied nearly all the time of the Senate on this bill, I have not done it to the exclusion of any Senator who desires to speak, and therefore I will venture even at this late moment to say a few words more regarding it, unless the Senate want to adjourn.

The Senator from Maine [Mr. Hale] thought it very important to put the bill in a proper light before the Senate. He stated that it was necessary that he should put the bill in a proper light before the Senate in order that there might be no misapprehension of the objects of the bill and the persons it was intended to benefit. He stated that the bill was desired by all the people engaged in the industry of mackerel fishing, and that it was only opposed by the fishmongers of the city of New York. I am entirely willing to take the bill upon that basis.

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Mr. MILLER. Mr. President, it took several hours of discussion the other day to get at the purposes and objects of this bill, but I think the discussion finally brought out very clearly to the Senate the objects and merits of this measure.

The Senators from Maine told the Senate that there were none of the citizens of the United States interested in this measure save the few mackerel fishermen in the States of Massachusetts and Maine, and that therefore the Congress of the United States ought to hasten to pass this measure as a measure of relief to the fishermen who had petitioned for it.

It seems that there are about 400 vessels engaged in mackerel fishing, giving employment to several thousand men, just how many I do not know, perhaps four, five, or six thousand, all told—about six thousand the Senator from Maine [Mr. Hale] says.

From the arguments produced here in favor of this bill the Senate might be led to suppose that the bill had been brought here for the purpose of protecting mackerel fishing; that there was great danger of the species being entirely destroyed, and thus one of the chief fish-food products of the country being entirely obliterated; but neither the testimony taken by the committee nor any

testimony of any scientific man in the world has been produced here to show that there is the least danger or, in fact, the least probability of any such result ever being produced by the unlimited and unconditioned fishing going on, such as has been pursued for the last ten or fifteen years with purse seines. In short, the best scientific men in the world have agreed that thus far man has been able to produce no appreciable effect upon the fish which swim in the deep sea. Therefore we have no data upon which to base any proposition whatever that if this fishing shall continue unlimited in the future as it has been in the past, any such result whatever will be produced.

This being the fact, why is it that the owners of these 400 vessels, who have a large amount of capital invested in this business, come here and ask Congress to limit their action and to take out three months of the twelve and absolutely prevent or prohibit purse-seine fishing? They have a monopoly of the business now; it is so conceded by both the Senators from Maine, who have told us that there is not a single vessel owned in any other State of the United States engaged in this industry save in the States of Massachusetts and Maine, and that no one else has any interest in it whatever. Why come here, then, asking a prohibition on the part of Congress? One would suppose that they would be anxious to continue their business during the whole twelve months of every year, and make it as large as possible; and why not? Because they have found that by the improved methods of fishing which are now in use by these fishermen they have so increased the amount of fish brought into our markets that prices have been greatly reduced, and, therefore, the profits of the capital invested in this business have been somewhat decreased. Therefore they come here to ask Congress to legislate against themselves, or, in short, to protect themselves from their own industry. There are so many of them, doubtless, that it is impossible that they should form an association and agree by common consent to give up fishing for three months in the year. Undoubtedly a large number of them would be glad to do that, but no one fisherman and no one firm engaged in this business will consent to abstain from fishing for three months in the year unless all are compelled to do so.

Now, what is the object of a cessation of fishing for three months? It is all folly to come here and tell the people of the United States that the fishermen who control these vessels and who have their capital invested in the business are philanthropists, and that they are asking to be curtailed in their own operations simply for the purpose of preserving the mackerel species as a food product for the people of this country. I say it is all folly to come here with any such assumption as that.

We see frequently associations of different industries in this country, in which the capitalists interested in and the proprietors of great industries get together and agree to curtail the production of a particular industry—for what purpose? For the purpose of increasing the price by decreasing the supply. Have we not seen the Bessemer-steel manufacturers of this country get together in their associations and agree to close their works for three months or six months?

What for? For the good of humanity? For humanitarian purposes? Not at all; but simply that they might reduce the production of Bessemer-steel rails, and thereby increase the cost; and our friends on the other side of the Chamber have come here and taunted the protectionists of this body with this very charge that the Bessemer-steel manufacturers of this country had done this thing. It has been done by other manufacturing associations, but they have not come here and asked Congress to shut up all the Bessemer steel-rail factories for three months in the year lest there should be a surplus of Bessemer steel.

The cotton manufacturers, who sometimes close down their works for thirty days or six months, have not come here and asked Congress to pass a law that there shall be no manufacturing of cotton goods for three months or six months in the year in order that the amount produced may be reduced and thereby the price increased. But here comes an industry confined, as the Senators from Maine and Massachusetts show, to their own States, having an absolute monopoly, owning every vessel engaged in it, and having all the capital invested in it, and all the men who are employed upon their ships citizens of their own States, and it asks Congress to say that for three months in the year there shall be no fishing with purse seines by this industry.

Mr. President, as I said before, these fish swim free in the ocean. They cost us no labor and no pains in their growth. They are there free for all our people to take, and they furnish one of the great supplies of food for all our people. The fisheries of every country have been protected, and nations have gone into great and costly wars in order that they might protect their fisheries because they were a source of great profit to the people, but never before in the history of the world has a nation undertaken to say to its own citizens, "You shall not fish upon the high seas for three months in the year," or for any other time.

Now, let us see what the value of the catch of mackerel has been in this country for the past few years, and see how greatly it has been reduced in its price to all our people.

In 1863 the value of the mackerel catch, as it sold at the high price which then prevailed, was $5,935,525; in 1869 the mackerel caught in that year sold for $3,248,315; in 1871 the catch of mackerel inspected in Massachusetts amounted to $2,233,055. The catch that year was 259,000 barrels. Of late the price of mackerel has been greatly reduced in all our markets. The numbers caught and brought to our shores have been so great that, following the ordinary law of political economy, the supply being large, the price has been reduced, and all our people have obtained fish food at very low rates.

In 1883 this large amount of mackerel sold for $1,619,000; in 1884 the catch sold for $1,853,000, and in 1885 for $1,230,000 only.

These figures prove conclusively why this bill is brought here. A very large proportion of the year's catch is made in the months of March, April, and May, and this bill proposes that during those three months there shall be no fishing for mackerel with purse seines at all. If this bill becomes a law it will reduce the catch of mackerel probably 50 per cent for the next year, and what will be the result? The 50 per cent less of fish will sell in our markets for as much money as the large catch of last year did. In other words, the American people will be compelled to pay to the capitalists who control this business in those two States as much money for one-half of the amount of fish food as they paid for the larger amount last year. That is all there is of this. We are asked here to shut up and control the fish on the high seas for three months in the year in order that the price of fish food may be advanced from 50 to 100 per cent. That is all this bill is intended for, and it is precisely what the bill will accomplish if it is enacted into a law.

Mr. President, it has been charged here that there has been no opposition to this bill from any source except from the fishmongers of New York City and other Atlantic cities. I need not say to you or to the Senate that the poor people of this country, the laboring men and the farmers of this country scattered broadcast over the whole land, are not organized in such a way that they can come here to protest against the passage of this bill. Neither need I say to you, sir, that not one-tenth of 1 per cent of the people of the United States who consume fish as a portion of their daily food have any possible knowledge that any such bill as this is before the United States Senate. You will not be able to make any considerable portion of the people of this country believe for a moment that the Congress of the United States can be brought to the condition where it will say to its own people and to its own citizens that they shall not go on the high seas and fish for this food, which is free to all the world.

We may shut our own people out from these waters for three months, but we can not shut out from these waters the people of our neighboring countries. We can not shut out from them the Canadian fishermen. We may close our own ports to this food-fish and and say that our people for three months shall not have it, and that for the remaining nine months of the year they shall pay from 50 to 100 per cent more for the fish which they consume than they would if this bill should not pass.

It does not seem possible to me that the Congress of the United States should patiently consider such a proposition as this, for not only will this enhance the cost to all our people of mackerel, but it will undoubtedly to a large degree increase the cost of all salt-water fish, of codfish, of bluefish, and of the various varieties which come into our markets. Anyone familiar with this subject knows that during all the summer months fresh mackerel are brought into all our ports, and that they to a large extent, if not entirely, control the price of all the fish to be found in our markets. If mackerel are caught in large quantities, of course the price goes down to all the people, and it carries with it the price of other kinds of fish to a certain extent.

I can find nothing in this bill, I say, save the proposition to prohibit the fishing for three months in order that by doing so we may greatly decrease the catch of mackerel, and thereby increase the cost or the selling price of that which shall be caught during the other nine months, and that additional cost is to be paid by all the people of our country.

Mr. PALMER. Mr. President, the Senator from New York does credit to his classical education in one respect. If I remember aright, whenever in the Iliad any of the gods or goddesses wanted to do anything that would not bear watching they always surrounded themselves with a fog. That seems—and I do not say it offensively, for possibly the Senator from New York may be a victim of his own hallucination—to be the result of his efforts in this case. We get up and dispel the fog, and in less than fifteen minutes the Senator has got himself, if not the Senate, enveloped in as dense a fog as his side of the question can demand.

What he wants is to obscure the real issue, it seems to me, and that is that the Fisheries Committee and the men who are pushing this bill are philanthropists. No such claim has ever been made. There is no claim of philanthropy about us except on the part of the Fisheries Committee.

We have acted judicially in this matter. The men who are pushing this bill have come to Congress and said that their business was languishing; it was in danger of being destroyed unless some protective measure was thrown around it. They asked that the close season be established. They are reaching out in various directions to find some remedy for the evil under which they labor, and it seems to me they make a very good case against the purse-seine fishing and in favor of the close season.

So much for that charge of philanthropy. Now, the Senator gets up and he takes this table, and I know that if he had had time to read it over critically he would not have made such an exhibition as he did in reading these figures this morning.

The Senator gets up and says that in 1863 the price paid for mackerel was $2,878,000, but he says that owing to the purse-seine fishing in 1883 the price had gone down $1,619,000. If he had looked at the question critically, he would have seen that the price has been affected more by the degradation of the fish, by the quality running down, than by any other cause. For instance, in 1863 the percentage of No. 1 mackerel was 22 per cent, and in 1883 it was 14 per cent. He will find also that in 1885 215,000 barrels sold for $1,230,000, whereas in 1883 154,000 barrels sold for $1,619,000. There was a larger amount, 215,000 barrels, against 154,000, and the 215,000 brought $1,230,000 and the 154,000 brought $1,619,000; and what was the reason? The reason was that in 1883 the percentage of No. 1 mackerel was 14 per cent, and in 1885 it was 7 per cent. If there is anything in figures, it seems to me that that is very fully proven.

Mr. MILLER. I think the Senator has proved my proposition exactly. They want to reduce the amount of fish caught and therefore increase the price, and that is what they will do if the bill is passed.

Mr. PALMER. That is not the animus of the bill, nor is it fairly inferable, it seems to me, from any of the arguments used or any of the statements made before the committee. It is the running down of the quality that they complain of, and that causes the present state of their business and the present low prices that they receive for mackerel. It seems to me that they are right. The Committee on Fisheries have no interest in the matter, save to see that justice is done to a great and important interest.

Now, who are to be benefited by this bill? Primarily those men whom the Senator from New York calls monopolists. They have the monopoly of the business now. It makes no difference to them whether they take their fish down on the coast of New Jersey or up on the coast of Massachusetts if it is equally profitable; but it makes a great difference if it is not profitable, and if it is the cause of the decrease of the profits in their business. It also is a matter of interest to the people along the shore of Delaware and New Jersey that they shall be disturbed in their fisheries along the borders of their States with hook and line. This is merely a crusade against purse-seine fishing in the spawning season; and, taking all the statements from the different gentlemen who appeared before the committee, it seems to me that the Senate can not come to any other conclusion than that the proper thing to do is to pass the bill.

Mr. MILLER. The Senator seemed to make an entirely different statement in regard to the danger of the destruction of this fish as a fish called mackerel. I want to ask the chairman of the committee now, in all seriousness, whether there is a particle of scientific evidence anywhere in the world going to show that it is possible for man, with all the modern devices and means of fishing, to in any way perceptibly diminish the number of fish in the sea?

Mr. PALMER. I am coming right to it, and I can best illustrate it to the gentleman by a little figure of speech.

The conclusion arrived at by Professor Huxley, when he made that investigation in regard to the herring fishery, seems to be the bulk of the opposition. Now, Professor Baird has said, and the Senator read so on Tuesday, that it might be well to try the experiment; that it is possible that the purse-seine fishing might in time lessen the quantity of mackerel. Professor Goode, the next highest in authority, said that if it did not destroy the mackerel it might deflect them from their ordinary route and course. Captain Collins, possibly the best practical man in the Fish Commission, a man in whom Professor Baird has the highest confidence, believes that it does deflect them from their course. But I was going to answer the gentleman's question by another, or rather by a little illustration.

What difference would it make to him if a lot of Apache Indians came to his farm in Herkimer County, New York, and killed his cattle and carried off the beef, or whether they drove the cattle down into Mexico, and over the border; he loses his cattle in either case. In one case the country is not depleted of cattle; there are just as many cattle, but they are not where they are available to him.

This is a parallel case. They are driving the old and the wise and the mature mackerel off from our coast, and there is no other conclusion you can come to by looking at these tables. Have I answered the gentleman?

Mr. MILLER. To the satisfaction of the chairman of the committee, I have no doubt, but scarcely to the satisfaction of the Senator from New York.

I am not able to see the wisdom of cutting off fishing entirely for fear that in some future ages, it may be a geological period of a million years more or less, we can not tell when, if this thing be allowed to go on there may be some diminution in the number of fish, or, as the Senator says, we may frighten the wise and old fish away from our shores by the harassing methods of purse-seine fishing.

Mr. PALMER. Will not the Senator allow me to go on? It seems I have pierced his armor, and if he does concede that in course of time the fish in the sea may be affected by this wholesale purse-seine fishing——

Mr. MILLER. No; I do not admit that even in the course of time that may be so. It can not happen.

Mr. PALMER. If the Senator will confine his remarks to questions and not let them elongate into speeches, I shall be willing to answer anything that he propounds, if I can.

Mr. MILLER. I was trying to follow the example of the distinguished chairman of the committee in making my questions as long as he makes his answers to some questions that I have propounded; but I have not succeeded in doing that, and therefore I will come back to the more ordinary and straight Anglo-Saxon style. Why not then, as I have asked before, I now ask the chairman if he fears the driving away of these fish from our shores by frightening the old and wise ones by purse-seine fishing—why not prevent fishing entirely for the other nine months in the year; why allow it to take place only off the coast of Maine and Massachusetts?

Mr. PALMER. I will get the Senator on the general question if he will not go on and make another speech. I will tell you the reason. It is because purse-seine fishing is much more economical than fishing by hook and line; and the regard of the Fisheries Committee and of the fishermen of Massachusetts and Maine for the constituents of the Senator from New York to the extent that they may have cheap food and cheap fish, has merely asked for a three months' close season instead of a six months' close season. It is much more economical to take fish with the purse seine than with the hook and line. The cheaper fish is caught the cheaper it can be sold. That is the reason that it would be followed.

Another thing, the spawning season is past, and the timidity which we know affects all animals about the reproductive period has disappeared, and the raid made upon these immense schools does not have the same effect upon them that it does about the reproductive period. Is that satisfactory to the Senator from New York?

Mr. MILLER. No; it is not satisfactory at all. I am not able to understand why the Senator desires to stop purse-seine fishing when the fish are off the coast of the Carolinas and Virginia and New York, and he is willing to let it go on during the remainder of the year when the fish are off the coast of Massachusetts and Maine. I do not see why he wants to preserve the fish in every case and prevent their being frightened by these terrible fishermen, and is entirely willing they should carry on their nefarious methods off the coast of Maine and Massachusetts.

Mr. PALMER. If all the explanation I have made in regard to the damage to the fish during the months from the 1st of March to the 1st of July is not satisfactory to the Senator from New York, though one should rise from the dead he could not be affected. I think I have answered that question fifteen or twenty times. It is not because they appear off the coast of North Carolina, or off Hatteras or New Jersey, that the close season is established; it is not because the people of those States are to be discriminated against; but it is because the fish, in the first place, are comparatively good for nothing; and, in the second place, it is the spawning season and the schools are broken up and they are deflected from their proper route and from their feeding grounds.

The Senator from New York says that the object of this bill, the reason that it is pushed at the instance of the fishermen from Maine and Massachusetts, is that as the catch of fish has been increased the price has run down. That is not the fact. The price has not run down, as the tables show, except as the quality has carried it down. You will find the low prices follow the quality rather than the amount.

The gentleman says that it has been the policy of all civilized people in all times to protect their fisheries. That is just what we are trying to do to-day. We are doing what 5,000 fisher-

men along the coast of Massachusetts and Maine ask us to do, who tell us that their equipment and their ships have run down from 100 cents on the dollar to 25 or 50 cents on the dollar, and they ask this relief. It is not going to interfere with any one except the retail dealers or the wholesale dealers in fish in the city of New York, and there is no one that has appeared before the committee to oppose the bill except Mr. Blackford, for whom I have a very high respect, and Mr. Benjamin, who seems to be a very pleasant gentleman, but who is working for his own interest; and right here I would like to read to the Senate what Mr. Blackford, who opposes the enactment of this bill, says on the subject. He is asked this question:

If it drives them off it is just about as bad as if you destroyed them?

Mr. BLACKFORD. Exactly so; but the same argument will apply to fishing at any season of the year. It would apply to your fishing in September and October, and would apply to all other kinds of fish. There is no doubt—any person who goes fishing knows—that if you disturb the fish or break up their schools you are in danger of driving them to seek new feeding grounds and to seek new spawning grounds.

Mr. Blackford is asked this question:

The CHAIRMAN. It seems to me it would not to the same extent. If you give them three months' relief in this pursuit when they are advancing on a certain line, they would be apt to have their yearly run-ways and they will keep up that line?

Mr. BLACKFORD. Yes, sir; if you catch next year only one-half as many fish as you catch this year, the probability is there will be a good many more left.

The CHAIRMAN. Are they not more timid, as all animals are, just about the reproductive time than any other, and would not any infringement upon their routes have a more disastrous effect then than it would have when they were not in the reproductive time?

Mr. BLACKFORD. I am inclined to think so, for the reason that the fish come closer to the shore after the spawning season is over. That of itself would indicate that they are not so shy after spawning as they are before.

I shall not take up the time of the Senate with any more remarks. It seems to me that it is made perfectly plain that a great industry is suffering, that those engaged in it are entitled to relief at the hands of Congress, particularly the fishing interest, the nursery of our Navy.

The measure was passed by the Senate on February 10, by a vote of 34 to 11, 31 not voting.

The Senate amendments to the bill were agreed to by the House, and the measure as finally passed and approved by the President on February 28, 1887, was as follows:

AN ACT relating to the importing and landing of mackerel caught during the spawning season.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the period of five years from and after the 1st day of March, 1888, no mackerel, other than what is known as Spanish mackerel, caught between the 1st day of March and the 1st day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores: *Provided, however,* That nothing in this act shall be held to apply to mackerel caught with hook and line from boats, and landed in said boats, or in traps and weirs connected with the shore.

SEC. 2. That section 4321 of the Revised Statutes is amended, for the period of five years as aforesaid, so as to read before the last sentence as follows: "This license does not grant the right to fish for mackerel, between the 1st day of March and the 1st day of June, inclusive, of this year." Or in lieu of the foregoing there shall be inserted so much of said period of time as may remain unexpired under this act.

SEC. 3. That the penalty for the violation or attempted violation of this act shall be forfeiture of license on the part of the vessel engaged in said violation, if a vessel of this country, and the forfeiture to the United States, according to law, of the mackerel imported or landed, or sought to be imported or landed.

SEC. 4. That all laws in conflict with this law are hereby repealed.

In closing this consideration of the suspension of the fishery, it is worthy of note that the protection which Congress sought to accord the mackerel was not directly given through any assumption of right or power to legislate for a fishery prosecuted in the open sea, but was indirectly brought about by recourse to a regulation of the customs service, forbidding the landing of mackerel during the proscribed season.

INTERPRETATION OF THE CLOSE-TIME LAW.

When the time came for the enforcement of the close-time law, some doubt arose in the minds of the officials of the Treasury Department as to the interpretation to be placed on the words in the act exempting from its provisions "traps and weirs connected with the shore." It was evident that a strict application of the law, as worded, would result in a very serious drawback to the important pound-net, trap, and weir fisheries along the coast of the Middle and New England States, in that very few of the nets of this character are actually connected with the shore (that is, the land); mackerel constitute, in most cases, only a part of the catch, and when taken could not be returned to the water without much trouble, granting the wisdom of such a procedure by supposing that the fish could be released in an uninjured condition; and the expense and labor necessary to extend the leaders of the nets to the land would be useless so far as the fishery would be benefited and would result in no possible good, so far as compliance with the law was concerned.

Aside from the interpretation of the law, the matter possessed considerable interest in view of the question that was presented as to the power of Congress to legislate for fisheries prosecuted in shore waters usually regarded as being under the jurisdiction of the several States.

The petitions presented to Congress and the discussion of the matter by that body indicated that the proposed legislation was intended to restrict only the vessel fishery carried on with purse seines, which alone, in recent years, has constituted the southern spring mackerel fishery. The amendments to the original bill, exempting from its provisions the boat fishing with hook and line and the fishing with pounds and weirs connected with the shore, were clearly designed to prohibit any interference with the shore fisheries of our coast. The wording of the bill was, however, ambiguous, or, at least, was susceptible of a construction which was evidently not intended by most of those favoring the measure.

The following correspondence, passing between the Treasury Department, the United States Commission of Fish and Fisheries, and private persons as to the construction to be put on the part of the act referred to, possesses considerable interest and importance. It will be seen that the ruling of the Treasury Department was based on a literal interpretation of the law and that the word "shore" was regarded as being the line of mean low water.

[Messrs. T. J. Jones & Co., Boston, Mass., to the Secretary of the Treasury, April 30, 1888.]

We are informed that the United States consul at Liverpool, Nova Scotia, holds that the words "traps and weirs connected with the shore," in the act of Congress relating to the importation of mackerel caught between the 1st of March and the 1st of June, can be construed to include nets anchored to the bottom, even at some distance from land, and the interpretation of the collector of this port is that a trap is a technical designation and does not cover nets and seines.

[Acting Secretary of the Treasury to the Commissioner of Fish and Fisheries, May 4, 1888.]

I inclose herewith a letter dated the 30th ultimo, received from Messrs. T. J. Jones & Co., from which it would appear that a difference appears in the construction placed upon the words "traps and weirs connected with the shore" (as contained in the act of February 28, 1887) by the United States consul at Yarmouth, Nova Scotia, to the collector of customs at Boston, and will thank you to return the inclosure with an expression of your views in the matter.

[Assistant Secretary of the Treasury to the Commissioner of Fish and Fisheries, May 21, 1888.]

Referring to this Department's letter of the 4th instant, requesting your opinion as to the construction to be placed upon the words "traps and weirs connected with the shore," as contained in the act of February 28, 1887, I inclose herewith a letter dated the 11th instant, received from the custom-house at Barnstable, Mass., requesting information as to how the shore line is to be regarded in connection with said act; that is, whether high or low water mark is meant by the same. I will thank you for an expression of your views in this matter in connection with your reply to the Department's letter of the 4th instant, and would request that the inclosure of both letters be returned with your answer.

[Collector of customs, Barnstable, Mass., to the Commissioner of Navigation, May 11, 1888.]

Will you kindly furnish this office with information as to how the "shore line" is regarded by the Department; i. e., whether the low-water mark is meant by the same. I have also respectfully asked that you instruct me how to proceed in case mackerel, illegally caught and landed before June 1, 1888 (inclusive last-named date), are seized by customs officers in this district. In case mackerel were seized they would spoil before the Department could be consulted with.

[Commissioner of Fish and Fisheries to the Assistant Secretary of the Treasury, May 23, 1888.]

Referring to your letter of May 21, 1888, requesting the opinion of the Commissioner of Fisheries "as to the construction to be placed upon the words 'traps and weirs connected with the shore,' as contained in the act of February 28, 1887," and inclosing a letter from the custom-house at Barnstable, Mass., "requesting information as to how the shore line is to be regarded in connection with said act—that is, whether high or low water mark is meant by the same," I beg to reply that in my judgment the line of mean low water is to be regarded as the shore line, for the reason that titles of riparian owners extend to this line.

The provision of the act referred to, exempting specifically from the operation of the law traps and weirs connected with the shore, was designed to bring under the restraint of the law traps or pounds anchored in deep water offshore, and not connected with the same by fence or hedging. A pound, trap, or weir having a hedging extending from the trap, weir, or pound to the shore, as defined by mean low water, would clearly come under the exemption, even if the weir or trap in which the fish are impounded is a mile or more from the actual shore line.

The letters of inquiry addressed to the Secretary of the Treasury and transmitted as inclosures in your letters of May 4 and May 21, are herewith returned as requested.

[Acting Secretary of the Treasury to the Secretary of State, May 23, 1888.]

Referring to telegram of the consul at Yarmouth, left at this Department this morning, in which he desires to be informed if mackerel now being caught in twine nets attached to the shore, straight line, are entitled to free entry the same as if caught in weirs, I have the honor to state that it has been ascertained, by a conference with the office of the Commissioner of Fish and Fisheries, that mackerel thus caught are not caught in traps or weirs as provided in the act of February 28, 1887, and are therefore not entitled to free entry. I return herewith the telegram aforesaid.

[Assistant Secretary of the Treasury to the collector of customs, Barnstable, Mass., May 26, 1888.]

Referring to your letter of the 11th instant, in which you request to be furnished with information as to how the "shore line" is regarded by the Department—i. e., whether high or low water mark is meant by the same—you are informed that the Commissioner of Fish and Fisheries states that in his judgment "the line of mean low water is regarded as the shore line, for the reason that titles of riparian owners extend to this line."

The Commissioner further states as follows:

> The provision of the act referred to exempting specifically from the operation of the law traps and weirs connected with the shore, was designed to bring under the restraint of the law traps or pounds anchored in deep water offshore and not connected with the same by fence or hedging. A pound, trap, or weir having a hedging extending from the trap, weir, or pound to the shore, as defined by mean low water, would clearly come under the exemption, even if the weir or trap in which the fish are impounded is a mile or more from the actual shore line.

With regard to your further inquiry as to how to proceed in case mackerel, illegally caught and landed before June 1, 1888 (inclusive of the last-named date), are seized by customs officers in your district—you stating that in case mackerel are seized they would spoil before the Department could

be consulted—you are informed that seizures under this act should be proceeded with in the manner prescribed by the Regulations for other seizures. (See articles 1098 and 1107, Regulations, 1884.)

The limitation of one week prescribed in article 1104 as to notice by advertisement may, if circumstances necessitate, be waived and the fish sold under such due and timely notice as will answer the purposes intended to be secured by the provisions of the Regulations in that respect.

[Assistant Secretary of the Treasury to the Commissioner of Fish and Fisheries, June 14, 1889.]

Referring to your letter of May 23, relative to the definition to be placed upon the words "traps and weirs connected with the shore," as contained in the act of February 28, 1887, I inclose herewith a communication, dated the 6th ultimo, received from Mr. A. F. Crowell, of Boston, requesting a ruling by the Department as to the right of traps and weirs in waters within the limits of the States. The matter was referred to the Solicitor of the Treasury for his opinion by Department's letter of May 13, 1889 (also inclosed), and that officer's reply of the 28th idem has been received, in which he intimates that Department's decision of May 26, 1888 (S. 8864), which was based upon your letter above referred to, is inconsistent with what he considers the proper construction of the act in question.

The Solicitor's opinion is also inclosed, and I will thank you to return all the documents herewith transmitted with an expression of your views on the question involved.

[Mr. A. F. Crowell, Boston, Mass., to the Secretary of the Treasury, May 6, 1889.]

On behalf of the Net Fishermen's Association, who are engaged in fishing with traps and weirs, would respectfully ask a ruling on the meaning of that part of the act of February 28, 1887, relating to the importing and landing of mackerel caught during the spawning season, which reads:

Provided, however, That nothing in this act shall be held to apply to mackerel caught with hook and line from boats and landed in said boats or in traps or weirs connected with the shore.

It is reported that a ruling has been made that in order to conform to the law a trap must have a connection with shore to low-water mark. We feel that if this is true it is not a correct ruling and works harm to the fisherman, as it is an unnecessary expense for him to set a leader to trap in shoal water, as no more fish are caught thereby. The bill itself was passed to prevent the taking of mackerel by seines and purse nets, as reported by Hon. Thomas W. Palmer, from the Committee on Fisheries, submitted to the Senate July 29, 1886.

Again, the Committee on the Judiciary, to whom was referred House bill 4690, report (see Bulletin of the United States Fish Commission, 1886, page 117):

Your committee, therefore, being of opinion that the navigable waters within each State belong to it, subject to the paramount right of navigation for the benefit of its own people, it has the right to secure the exclusive right of fishing in them to its own citizens by virtue of their common property in said waters, and that the citizens of other States have no constitutional right, nor can Congress confer any, to participate in fishing in them.

This matter of right of Congress in regard to the fisheries having been reported upon at the time of the committee report on the "close season bill," it would indicate the close season for catching mackerel was for the purpose of prohibiting the catching of mackerel outside of the limits of State waters, and the wording "connected with the shore" was in reference to the "shore fisheries" as defined from "deep-sea fisheries," and was limited to the waters of the State and not confined to the low-water mark, as the decision of the Supreme Court of the United States has been that Congress or the United States has no authority over the fisheries in the waters within the limits of each State as referred to above, and as the State of Massachusetts grants licenses to set traps and weirs in the navigable waters of the State, and as the United States license to vessels is for deep-sea fishing, we hold it was not the intent of Congress to control the shore fishing, and that it has no constitutional right to do so.

We therefore respectfully ask that a ruling be made in reference to that part of the bill as has reference to fishing by traps and weirs.

[Assistant Secretary of the Treasury to the Solicitor of the Treasury, May 13, 1889.]

I inclose herewith a letter, dated the 6th instant, received from A. F. Crowell, of 28 State street, Boston, asking, in behalf of the Net Fishermen's Association, a ruling as to the meaning of that part of the act of February 28, 1887, entitled "An act relating to the importing and landing of mackerel caught during the spawning season," which refers to mackerel caught with hook and line from boats and landed in said boats or in traps or weirs connected with the shore. The matter has been to some

extent considered by the Department, and it was held in its decision of May 23, 1888 (S. 8856), that mackerel "caught in twine nets attached to the shore, straight line," were not entitled to entry under the act.

In its decision of May 26, 1888 (S. 8864), the definition given by the Commissioner of Fish and Fisheries as to the shore line referred to in said act, and as to the design of the act with respect to traps and weirs, was promulgated for the information and guidance of collectors. The questions now raised by Mr. Crowell relate to the authority of the States over navigable waters within their boundaries, and I would respectfully request a return of the letter, with an expression of your views thereon, at your earliest convenience.

[Solicitor of the Treasury to the Secretary of the Treasury, May 28, 1889.]

I am in receipt of a letter addressed to this office by Assistant Secretary Tichenor, under date of the 13th instant, requesting an expression of my views of the question raised by Mr. Crowell touching the authority of the States over navigable waters within their boundaries.

The inquiry is propounded on behalf of the Net Fishermen's Association, who are engaged in fishing with traps and weirs, as to the meaning of that part of the act of February 28, 1887, relating to the importing and landing of mackerel caught during the spawning season, which reads as follows:

Provided, however, That nothing in this act shall be held to apply to mackerel caught with hook and line from boats and landed in said boats, or in traps or weirs connected with the shore.

The object of the statute is to prohibit the importation into the United States of all mackerel, other than the Spanish mackerel, caught between the 1st day of March and the 1st day of June, inclusive, of each year for five years from and after the 1st day of March, 1888. The intention of the proviso quoted above is inferentially a recognition of the reserved rights of the States over their navigable waters and fisheries, but it is not readily perceived why the conditions touching the mode of fishing should be imposed, if intended to apply to such waters.

The grant of Congress to regulate commerce on the navigable waters of the several States contains no cession of territory or of public or private property; and the States may, by law, regulate the use of fisheries and oyster beds within the territorial limits, though upon navigable waters, provided the free use of the waters for purposes of navigation and commercial intercourse be not interrupted. (1 Kent Com., p. 439.)

The shores of navigable waters and the soils under them were not granted by the Constitution to the United States, but were reserved to the States respectively; and the new States have the same rights, sovereignty, and jurisdiction over this subject as the original States. (3 How., 212; 12 Id., 443.)

Title to land under water, and to the shore below ordinarily high-water mark, in navigable rivers and arms of the sea, was by the common law vested in the sovereign (94 U. S., p. 324); but since the decision in the Genesee Chief (12 How., 443), declaring all the great lakes and rivers of the country navigable that are so in fact, there is no longer any reason for thus restricting the title of the State, except as a change might interfere with vested rights and established rules of property. (94 U. S., 324.)

In this case the Supreme Court refer to the rule adopted in Iowa as the true one, namely, that the bed of the Mississippi River and its banks to high-water mark belong to the State, and that the title of riparian proprietors extends only to that line. Such beds and the maritime borders of States are held in some sense in trust for the enjoyment of certain public rights, among which is the common liberty of taking fish, and the State may regulate the mode of that enjoyment so as to prevent the destruction of the fishery and secure the privilege of its own citizens. This power results from the ownership of the soil, from the legislative jurisdiction of the State over it, and from its duty to preserve unimpaired those public uses for which the soil is held. (18 How., 71; 94 U. S., 391; 16 Pet., 367; 15 How., 426.)

The *jus privatum* of each State in its tide waters is subject to the *jus publicum* of the United States. (Aug. T. W., pp. 65, 160.)

The part of the sea which is not within the body of a county or the *fauces terræ* is considered as the "main sea" or ocean, and such is the interpretation of the words "high seas" in the penal code of the United States. (Aug. T. W., p. 4; 5 Wheat., 76.)

The seashore, or *litus maris*, is understood to be the margin of the sea in its usual and ordinary state, and when the sea is full the margin is high-water mark. The seashore is, therefore, all the ground between the ordinary high-water mark and low-water mark. (Aug. T. W., p. 71; 6 Mass., 435.)

Assistant Secretary Tichenor, in his letter referring the matter for an expression of my views, says:

> The questions now raised by Mr. Crowell relate to the authority of the States over navigable waters within their boundaries, and I will respectfully request a return of this letter with your views thereon.

The rights of the several States over navigable waters with regard to fisheries are, as we have seen, well defined by the highest judicial construction; and there is nothing in the act of February 28, 1887, to indicate that Congress intended to interfere with such rights, but rather, by the use of the words "no mackerel, other than what is known as Spanish mackerel * * * shall be imported into the United States or landed upon its shores," that it was intended to protect such fish during the spawning season in maritime waters not within the jurisdiction and control of the States. Synopsis 8864 does not appear to be inconsistent with this construction. As to the constitutionality of said act it is not the province of this office to determine.

[Commissioner of Fish and Fisheries to the Assistant Secretary of the Treasury, June 24, 1889.]

I have given careful consideration to your letter of June 14, 1889, and the accompanying correspondence, relating to the proper definition to be placed upon the words "traps and weirs connected with the shore," which occur in the act of Congress of February 28, 1887, and also containing certain propositions concerning the right of Congress to limit or control littoral fisheries in waters within the jurisdiction of a State or States.

As to the construction of the clause "traps or weirs connected with the shore," it is difficult to see how a strict interpretation of the words can differ from the meaning given to them in my letter of May 23, 1888, addressed to Hon. I. H. Maynard, Assistant Secretary of the Treasury. The proper construction of this clause depends upon the definition of the word "shore." If it is held that the shore goes beyond low-water mark, it will apparently be necessary to show to what distance it extends beneath the sea—that is, how far from mean low water fishing apparatus may be situated and still be "connected with the shore."

It is doubtless true, as claimed by Mr. Crowell, that it is a hardship upon the trap and weir fishermen to compel them in all cases to extend leaders from their apparatus to the shore, and thereby incur additional and otherwise uncalled-for expense. It is also quite supposable that the intent of Congress was not to place any unnecessary burden upon these fishermen.

Taking this view of the case, it may perhaps be assumed that the words "traps and weirs connected with the shore" were intended to apply to traps and weirs built out from the shore—along the coast near the land—as fixtures by driving stakes into the bottom or otherwise firmly securing the apparatus to the ground, and that this method of construction was considered by Congress sufficient "connection with the shore," even though the section of a trap or weir nearest the land might be several hundred feet distant from the line of mean low water. It is known to the Commission that in some localities, where the water is shallow, the inner ends of leaders to such devices are a mile or more distant from the shore, since no benefit can accrue to the fishermen by extending them farther landward.

Taking into consideration the whole tenor of the act referred to, it is not difficult to inferentially assume that it was the chief object of Congress to prohibit purse-seine fishing for mackerel (other than the Spanish mackerel) during their migratory period, when they are gravid and seeking their spawning grounds, and that the purpose was not to put any harsh restriction upon trap or weir fishermen, who generally take mackerel only incidentally, since their apparatus is built for the capture of other species.

The fact that it is clearly not in the power of these fishermen to prevent mackerel from entering their apparatus with other kinds, and that to throw them away after having been caught would be wantonly wasteful, without accomplishing any good purpose, no doubt had its influence in inducing Congress to permit the landing of all fish of this species taken in traps and weirs during the "close season."

But while the above assumptions appear to be well founded, and while it would be gratifying to see the fishermen relieved from any unnecessary hardship by a liberal ruling, I nevertheless can not venture to put a construction upon a law that does not seem to be fully justified by the words employed by Congress. To hold that the word *shore,* as used in the act under consideration, means a mile (or any other distance) from the shore line at mean low water would be taking a responsibility which seems unwarranted.

Regarding the question raised by Mr. Crowell respecting the authority of the States over navigable waters within their boundaries, and the opinion given thereon by the Solicitor of the Treasury, I have the honor to state that, in my opinion, it is clearly not the province of the Fish Commissioner to discuss purely legal questions, such as the constitutionality of the act of February 28, 1887, or the right of Congress to limit, regulate, or control fisheries within the jurisdictional waters of the States. Anything, therefore, which I may write concerning the respective rights of the United States and the several States should not be taken as an expression of opinion, but more for the purpose of calling your attention to the various phases of the question as bearing upon the fisheries.

If the claim is correctly made by Mr. Crowell that "the United States has no authority over the fisheries in the waters within the limits of each State," and this has been supported by decisions of the Supreme Court of the United States, then it would appear that the General Government can place no restriction upon the use of any form of apparatus for the capture of mackerel within such limits, and the species may legally be taken at any time in gill nets, seines, or other movable fishing gear, operated near the land, as well as in "traps or weirs connected with the shore."

It must also be conceded that the United States has no authority to prohibit or control the catching of mackerel in traps or weirs located within the jurisdiction of a State, whether the apparatus is "connected with the shore" or not.

The authorities cited by the Solicitor of the Treasury, and the views expressed by him, support the contention of Mr. Crowell. He says:

> The rights of the several States over their navigable waters with regard to fisheries are, as have been seen, well defined by the highest judicial construction. And there is nothing in the act of February 27, 1887, to indicate that Congress intended to interfere with such rights, but rather * * * that it was intended to protect such fish (mackerel) during the spawning season in maritime waters not within the jurisdiction and control of States.

Accepting this view of the case, rulings of the Treasury Department would be noneffective, so far as relates to mackerel caught inshore along the coasts of the several States, and such rulings can be applied only to mackerel imported from foreign countries.

Here it may be proper to refer to the paragraph of your letter of May 13, 1889, to the Solicitor, in which you state that, by a decision of the Treasury Department of May 23, 1888, "mackerel 'caught in twine nets attached to the shore straight line' were not entitled to entry under the act."

This decision was evidently correct, insomuch as it applied to fish imported from foreign countries, and the straight "twine nets" in which they were taken were apparently gill nets, and would not come under the classification of "traps and weirs" specified in the act.

However, the respective rights of the General Government and the States in the control of the inshore fisheries appear to be not always clearly defined. In opposition to the propositions so ably set forth by the Solicitor of the Treasury may be mentioned the well-known historical fact that the General Government has on more than one occasion assumed control over the inshore fisheries of certain States to the extent of concluding treaties with foreign nations whereby the citizens of those countries were granted the right to participate in the littoral fisheries of the States (with the exception of shell fisheries) without any specified restriction as to the season or form of apparatus to be employed, and without being amenable to State laws relating to the fisheries.

Notable among such treaties are the so-called "Reciprocity Treaty" concluded with Great Britain in 1854, and also the Washington Treaty, negotiated with the same Government in 1871.

[Secretary of the Treasury to Mr. A. F. Crowell, Boston, Mass., July 5, 1897.]

Your communication of May 6 last, requesting a further ruling by the Department as to the meaning of that part of the act of February 28, 1887, relative to the importing and landing of mackerel caught during the spawning season, which reads, "Provided, however, nothing in this act shall be held to apply to mackerel caught with hook and line from boats and landed in said boats, or in traps or weirs connected with the shore," was duly received and has been carefully considered, and in replying I have to state that the Department must decline at this time to make any other or further ruling as to the application of said act than has been promulgated.

RESUMPTION OF THE FISHERY IN 1893.

The resumption of the southern spring mackerel fishery in 1893 was an important event in the history of the New England fisheries, and its result was watched with much interest by fishermen, vessel-owners, and fish-dealers. The opinion was advanced in some quarters that the reappearance of mackerel in abundance would demonstrate the wisdom of the legislation cited, and constitute a valuable precedent for other regulations of the ocean fisheries by the Federal Government; while, on the other hand, it was held by some that a scarcity of mackerel would show that the decrease in the abundance was due to other causes than the influence of man. Still others, who placed no reliance on the efficacy of legislation of this nature, attached no importance to the success or failure of the fishery.

It may safely be assumed that neither the abundance nor the scarcity of mackerel in the spring of 1893 would necessarily have proved anything as regards the effects of legislation. Five years are too short a time in which to satisfactorily and conclusively decide by such means a question of such moment. If the views now entertained regarding the rate of growth of the mackerel are correct, the fish hatched during the first and second years of the five-year period would hardly do more than reach the reproductive age before the expiration of the law, and could obviously have little noticeable influence on an increase in the supply, while the fish coming into existence in the latter part of the period would, on the renewal of the fishery, be more or less immature and in large part unmarketable.

On the approach of the usual time for starting on a southern cruise for mackerel, great activity was manifested in the principal ports having mackerel vessels, and a small fleet was fitted out and sailed from Gloucester, Boston, Portland, and elsewhere. The first vessel to start for the southern grounds was the schooner *Ethel B. Jacobs*, of Gloucester, which left port March 16. By the end of the month about a dozen vessels had sailed, but the majority of the fleet did not get under way till the first part of April.

The first mackerel news of the season was brought in by the schooner *Dido*, of Gloucester, which arrived from Georges Bank on March 23, and reported the capture on March 10, on the eastern part of the bank, in 40 fathoms of water, of a codfish in whose stomach a mackerel was found. As early as February 5, an old Gloucester mackerel fisherman, then employed in the coasting trade, observed five schools of mackerel about 75 miles off Cape Henry. The fish were first taken on March 19 by the schooner *Ethel B. Jacobs*, which arrived at Fortress Monroe, Va., on March 21 with four barrels of small fish; on the 19th instant, three days after leaving home, the vessel sighted a number of schools of mackerel, but they disappeared after the first set was made. Bad weather then intervened and prevented fishing.

The next news of the fish was brought in by the schooner *Joseph Rowe*, of Gloucester, which landed a fare of mackerel at New York on April 5. This cargo consisted of 25 barrels of fish only a few inches long, which were called by the fishermen "spikes"; the number contained in a barrel was 2,500, and they sold from 1½ to 3 cents each. On April 10 a part of the fleet was concentrated at Lewes, Del, on account of the weather; the vessels reported making hauls of 100 to 200 barrels of very small mackerel, which they turned loose. Up to April 14, returns from the fleet indicated that only small mackerel, not suitable for market, had been seen. The schooner *Joseph Rowe*, on April 16, brought in a second fare, consisting of 8 barrels of mackerel ranging from

14 to 17 inches in length, which were landed at Lewes, Del., and shipped by rail to Philadelphia. Five barrels of this lot sent to New York sold at the rate of 30 cents per fish.

Up to April 27 the vessels still remaining in the vicinity of Lewes had seen nothing but the small mackerel previously reported, but from that time until the latter part of May larger fish were sighted, and vessels arrived with small fares at rather short intervals. Most of the fish caught up to the middle of May were taken off Barnegat, N. J. On May 16, the United States Fish Commission schooner *Grampus* reported that on May 6, 7, 8, 9, and 10 large mackerel were fairly abundant in latitude 38° 20′, in 27 to 100 fathoms of water; they were, however, very shy and difficult to catch. By the middle of the month most of the fleet had left the southern grounds to seek the mackerel on the Nova Scotia shore.

The arrivals of fresh mackerel after the trip of the *Joseph Rowe* on April 16 were as follows: On April 27 the schooner *Mabel R. Bennett*, of Gloucester, landed 2,000 large mackerel in New York, most of which sold at 27 cents each. Four more Gloucester vessels arrived in New York with mackerel on May 3; these were the schooners *Harvard* with 7,000 fish, *Lewis H. Giles* with 6,000 fish, *Ethel B. Jacobs* with 6,500 fish, and *Lottie Gardner* with 2,500 fish; these were also large mackerel and mostly sold for 25 cents apiece. Two arrivals at New York on May 4, the schooners *Joseph Rowe* and *Marguerite Haskins*, had 4,840 large fish, which sold for 16 or 17 cents each. On May 6 the schooner *Hattie M. Graham*, of Gloucester, took 80 barrels of medium-sized mackerel to Philadelphia, where the fish brought 10 to 12 cents each. The schooner *Norumbega*, of Gloucester, arrived at New York on May 10 with 1,300 fish. On the following day the schooner *William H. Cross*, of the same place, brought in about 1,500 fish. Two days later the schooners *Marguerite Haskins*, *Eddie Davidson*, *Argo*, and *Caroline Vought*, the three last belonging in Gloucester, brought in about 27,000 mackerel. The fare of the first-named vessel, consisting of about 150 barrels, or 20,000 fish, was the largest single cargo landed in New York during the season. The price dropped to about 10 cents per fish.

Four more vessels brought in good fares on May 14; these were the Gloucester schooners *Lottie Gardner* with 80 barrels, *Abbie F. Morris* with 80 barrels, *Minerva* with 60 barrels, and *Senator Lodge* with 40 barrels. The next day the schooner *Joseph Rowe* arrived at New York with her fourth fare, consisting of about 3,500 fish, which sold from 6 to 10 cents each, and the schooner *Mabel R. Bennett* landed about 1,000 fish in New London, Conn. The schooner *Ethel B. Jacobs* reached Boston on May 17 with 9,000 fresh 14-inch fish, which sold for 9 cents each; they were taken on the edge of the Gulf Stream in latitude 38° 10′. The next day the schooner *Norumbega* reached Gloucester with 600 fresh fish. About this time some of the vessels still remaining in the southern waters found mackerel in the vicinity of Sandy Hook and carried small fares to New York on May 19, the schooners *Marguerite Haskins*, *Caroline Vought*, and *Argo* selling about 12,500 large fish. On May 24 the *Caroline Vought* landed another fare of 3,000 fish. The last vessel to go to New York with fresh mackerel was the schooner *Minerva*, which reached there May 26 with 1,200 fish, which sold for 25 cents each.

The mackerel fleet numbered 60 sail; of these 43 hailed from Gloucester, 3 from Boston, 11 from Portland, 1 from Rockport, and 2 from Dennisport. Several other vessels belonging in Provincetown and elsewhere sailed mackerel fishing in May, but

landed no fresh fish, and the information at hand fails to show that any mackerel were taken by them in the southern spring fishery.

The total quantity of fresh fish landed by the southern spring fleet was 1,158 barrels, or about 200,190 fish, with a value to the fishermen of about $21,000.

The number of trips of fresh fish landed was 30, giving an average of half a trip to a vessel and of 38½ barrels to a trip; 23 fares were taken to New York, 1 to Philadelphia, 2 to Boston, 1 to Gloucester, 1 to New London, 1 to Norfolk, Va., and 1 to Lewes, Del., for transshipment to Philadelphia and New York.

Only 16 of the vessels landed fresh fish, and of these only 3 secured more than 100 barrels; 7 others secured between 50 and 100 barrels. The average catch of the vessels that obtained fish was 72 barrels, or 12,512 fish, while the average for the entire fleet was 19 barrels, or 3,337 fish.

A few small fares of salt mackerel were landed from the southern fishing-grounds. Three vessels belonging in Gloucester that brought in no fresh mackerel landed 59 barrels of salt fish, 1 Boston vessel secured 12 barrels, and 3 Portland vessels are reported to have obtained 41½ barrels.

The following table, based largely on original inquiries, represents the details of this fishery; it shows the name and hailing port of each of the vessels engaging therein, the number of fares landed, and the number of fresh mackerel taken to market:

The southern spring-mackerel fleet in 1893.

Names of vessels.	No. of trips.	No. of fresh mackerel landed.
Gloucester:		
Abbie F. Morris	1	13,350
*Alva		
Ambrose H. Knight		
Argo	2	6,500
Caroline Vought	3	10,500
*Centennial		
Col. J. H. French		
Commonwealth		
Eddie Davidson	1	600
Eliza H. Parkhurst		
Ethel B. Jacobs	3	16,700
†Genesta		
George F. Edmunds		
Grayling		
H. W. Longfellow		
Harvard	1	7,000
Hattie M. Graham	1	11,000
Herald of the Morning		
*Herbert M. Rogers		
J. J. Clark		
James A. Garfield		
Jennie Seaverns		
John S. Presson		
Joseph Rowe	4	‡69,544
Lewis H. Giles	1	6,000
Lizzie M. Center		
Lottie Gardner	2	11,400
M. S. Ayer		
Mabel R. Bennett	2	3,000
Mabel W. Woolford		
Minerva		
Nellie M. Davis		
Norumbega	2	1,900
Gloucester—Continued.		
Quickstep		
Rapid Transit		
Robert J. Edwards		
Rushlight		
S. F. Maker		
Senator Lodge	1	3,954
Thomas F. Bayard		
Volunteer		
William H. Cross	1	1,547
Yosemite		
Boston:		
*Andrew Burnham		
Mertis H. Perry		
Roulette		
Rockport:		
Marguerite Haskins	3	26,970
Dennisport:		
Hattie and Lottie		
Lula E. Wilber		
Portland:		
*Ellen Lincoln		
Emma		
*Ethel and Addie		
Henrietta Francis		
Henry Morganthan		
John M. Plummer		
Laura Belle		
Lilla B. Fernald		
*Lizzie Maud		
Miantonomah		
Nathan Cleaves		
Total	30	200,190

* Landed small fare of salt mackerel. The aggregate catch of these vessels was 132 barrels.
† Lost on coast of New Jersey.
‡ Includes 62,500 very small fish.

The foregoing outline of the principal events in the history of the southern spring mackerel fishery in 1893 is perhaps sufficient to show its general result. It may be stated in addition, however, that the season was an unusually poor one. A few vessels made satisfactory fares, but many of the vessels failed to secure any fish whatever, and a large part of the fleet did not pay expenses. There have probably been very few years in the history of this fishery when so many vessels returned home entirely empty. The season closed and the fishery passed into history, to be classed with the numerous other general failures which have characterized the southern spring fishery.

It may be said that the practical failure of this fishery was not wholly due to a scarcity of fish. Many of the vessels that took no mackerel reported that plenty of fish were seen, but that they were unusually shy and difficult to catch. The shyness of the fish was thought to be due to a peculiar clear condition of the water, which the fishermen designate as "white water." When the seine was set it was readily detected by the fish, which sank in a body and came up outside the net. Even in the night, when seining is usually successful, the fish were often lost. A very large proportion—probably 90 per cent—of the fish taken, however, were secured at night.

The season was remarkable for the extremes of sizes represented by the fish landed. Some of the fares taken to New York consisted of fish that averaged larger than had been obtained South during any recent years, while one cargo was made up of much smaller mackerel than were ever before sold in that market, 2,500 fish being required to fill a barrel. The general catch, however, was large fish, of which 100 to 150 would fill a barrel.

The prices commanded by fresh mackerel in the New York and Philadelphia markets were very satisfactory to the fishermen and remained good throughout the season, there being no gluts, which in previous years had resulted in such loss to the vessels and such great waste of fish. Some of the first large fish received at New York sold from the vessel at 75 cents to $1 each. As other vessels arrived the price naturally fell, but always remained firm, ranging from 8 to 35 cents per fish, according to the condition of the market and the size of the mackerel.

REVIEW OF THE FISHERY FROM 1894 TO 1898 INCLUSIVE.

The southern spring mackerel fishery since 1893 has presented no especially noteworthy features, although it is desirable to briefly review it in order to make this history more complete. During no season from 1894 to 1898, inclusive, was the fishery successful, or did the catch approach anywhere near the figures reached prior to 1888. The outcome of the spring fishery in the South has been simply a forerunner of the results of the fishery on the New England coast, off the Nova Scotia shore, and in the Gulf of St. Lawrence, where the record of few fish and small catches that had characterized the fishery since 1886 was continued uninterruptedly. In only one season (1897) did the abundance of fish at times suggest the earlier days of the fishery and warrant the belief that the mackerel might be coming again in large numbers, and even in that year the final summation showed a catch that was large only by comparison with the four previous years of unprecedentedly poor fishing. An outline of the salient features of this fishery during each of these years may be of interest.

The spring mackerel fleet in 1894 numbered 50 sail. The first mackerel news was brought in by a coasting vessel which arrived at Philadelphia about April 1 and reported sighting schools of mackerel south of Cape Hatteras. Stormy weather prevailed in the early part of the season, and no mackerel were landed until April 19,

when 3 schooners arrived at New York and 2 at Philadelphia with from 20 to 50 barrels each. The next day 4 vessels landed 15 to 30 barrels each in New York, and another vessel reported a similar fare at the Delaware breakwater. All the foregoing fares consisted of very small fish, estimated at 80,000 in number; some of them sold for only one-fourth of a cent each, and the average was 2½ cents each. Throughout April most of the mackerel observed were these immature fish, known as "spikes," which had so little market value that the vessels were not warranted in catching them. The first large fish were landed at New York April 30; this trip comprised 20 barrels, and the mackerel sold for 30 cents each.

About May 1 the fleet fell in with schools of fish off Cape Hatteras and landed five cargoes in New York during the first week in May. There was one fare of 150 barrels of 1-pound fish, another of 100 barrels of medium fish, and a third of 90 barrels of medium fish, the others containing about 30 barrels each of medium fish. During the second week in May a large body of mackerel was reported off Winter Quarter Shoal light-ship, but the fish were extremely wild and difficult to catch, most of the seine sets being futile. Fishing was done chiefly at night, as a result of the shyness of the mackerel. About 100 barrels in five trips were caught during this time and landed in New York. The catch in 1894 had the distiuction of being, perhaps, the smallest since the fishery with purse seines was established. The 24 fares landed comprised 822 barrels, or 160,550 fish, for which the fishermen received $10,919. The average catch per vessel was only 16 barrels, valued at $218.

The poor outcome of the fishery in 1894 deterred many vessel-owners from sending their vessels out in the following year, the fleet numbering only 38 sail. The first vessel sailed March 31, and the first fare was brought in on April 16. This was caught by the schooner *Ethel B. Jacobs* on April 15, in latitude 36° 20′, longitude 74° 50′, and landed at New York. It consisted of 5,000 large mackerel, which were disposed of at 18 to 25 cents each. During April there were 6 other arrivals at New York and 1 at Philadelphia, the largest fare being 120 barrels of very fine fish taken to New York on the 29th by the *George F. Edmunds*, and selling for $2,600. A dense fog prevailed during the first two weeks of May and interfered with the fishing. The arrivals in May were 10 at New York, 1 at Philadelphia, and 1 at Gloucester, aggregating 448 barrels of fish, mostly large, selling for 15 to 22 cents each; about 16 barrels of salt mackerel were also landed. The season's catch was 973 barrels, or 121,050 fish, valued at $14,261. Twenty-six vessels failed to get any fish, and the average catch for the fleet was only 26 barrels, worth $381.

The southern mackerel fleet of 1896 numbered 39 sail, 7 of the vessels being from Portland, 4 from Provincetown, 1 from Dennis, 1 from Boston, and the others from Gloucester. The fishery was comparatively successful, the catch being larger than in any other year, except 1897, since the expiration of the close-time law. The first arrival was the *Kearsarge*, which reached New York April 10 with 1,665 large fish, weighing 1½ to 2 pounds, which sold at 40 cents each. The same vessel landed 2 other fares at New York during the month, aggregating about 26,600 tinkers and large fish, the former running 5 to a pound. Six other arrivals at New York and one at Hampton Roads in April comprised about 50,000 large and small fish. During the first half of May large mackerel were found in considerable abundance on the New Jersey coast, and later off New York. Fifty-five fares were landed during the month, 9 vessels arriving at New York on May 11 and 7 on May 12. The mackerel brought

from 10 to 20 cents apiece. As the vessels were bound home some of them fell in with fish east of New York and made fair-sized catches, which were landed at Boston, Gloucester, Provincetown, and Portland. The largest trips consisted of about 20,000 fish. Among the mackerel taken to Gloucester were some exceptionally large ones. A fish from the cargo of the *Norumbega* weighed $5\frac{1}{4}$ pounds, and 3 fish from the fare of the *James A. Garfield* weighed $4\frac{1}{4}$, $4\frac{1}{2}$, and 5 pounds, respectively.

The 64 fares of mackerel landed in 1896 were taken by 23 vessels, 16 of the fleet making no catch. Two vessels landed 6 fares each, 3 vessels had 4 loads, 8 vessels 3 loads, 6 vessels 2 loads, and 4 vessels 1 load. The fishery yielded 2,872 barrels, or about 317,000 fish, having a value of $41,790. The average catch per vessel was 74 barrels and the average stock per vessel was $1,072.

The southern mackerel season of 1897 was one of the most noteworthy in many years. While the catch was small compared with that of the years preceding the close-time law, it was so much in excess of the production in any season since 1892 that it will go down in history as a remarkable year. The fleet was unusually large for this period, numbering 84 sail, of which 61 hailed from Gloucester, 6 from Provincetown, 4 each from Boston and Portland, and 2 or 3 from each of 4 Maine and Massachusetts ports.

The first vessel to start south was the *Ethel B. Jacobs*, which sailed March 26. This schooner, on April 1, landed the first fare of the season at Fortress Monroe, Va., consisting of 20 barrels of tinkers, having an average weight of one-quarter of a pound; these fish brought 3 cents each. The catch was made on March 29, in latitude 31°. No other fish were brought in until April 17, when the same vessel landed 90 barrels at New York; these fish were 12 to 14 inches long and sold for 10 to $12\frac{1}{2}$ cents each.

From this time until the latter part of May there were almost daily arrivals at New York, Philadelphia, and other places. Fish were found in great abundance off the coasts of North Carolina, Virginia, Maryland, Delaware, and New Jersey. Some of the vessels sighted fish when only a few hours out from New York, and landed new fares within two days after discharging their previous loads; one vessel made the record of taking 3 cargoes to New York within a week. The mackerel were for the most part of medium size, although there was a good proportion of large fish, some of them being exceptionally fine and denominated "bloaters."

Between April 19 and 30, 20 fares of fresh mackerel were landed at New York and Philadelphia, the *Ethel B. Jacobs* bringing another load of 250 barrels on the 24th, and the schooners *Harvard*, *Lottie Gardner*, and *Carrie E. Phillips* each securing two fares. The largest cargoes were the fare of 250 barrels referred to and another of the same size taken by the schooner *Elsie M. Smith*. During this month the catch as landed amounted to 2,597 barrels, or 421,000 fish, valued at $19,752. The fish were mostly of medium size and the prices on certain days were as low as 3 cents apiece.

The first two weeks of May witnessed remarkable activity of the mackerel fleet. Seventy-three fares were brought in from the coast between Virginia and New Jersey. On the 6th and 7th 17 cargoes, aggregating 3,754 barrels, or about 402,300 fish, valued at nearly $39,000, were taken to New York and Philadelphia; these comprised the largest catches of the season, 3 of the vessels having 400 barrels each and 5 others from 250 to 350 barrels each. Many of the fish were large, 75 or 80 filling a barrel; these sold for 15 cents each, while the medium-sized fish brought from 6 cents upward.

Under the heading "largest for years," the Gloucester *Daily Times* of May 6 presented the following glowing account of the mackerel prospects:

Thirty-six hours from Fulton Dock, New York, and back again with 400 barrels of bloater fresh mackerel, which are selling at 15 cents apiece. Such is the news as telegraphed to the *Times* this morning from New York in regard to the schooner *Marguerite Haskins*, Capt. Charles Harty, of this port. Just think of it. In these years, when 100 barrels is a good and 200 barrels an extra big trip out south, to hear of a vessel getting in with 400 barrels and all big ones at that. Captain Harty is to be congratulated on his great good fortune. May there be others to follow

While everybody was yet wondering at the big trips and speculating on the probable stocks and whether anybody else was on the way, another telegram at the *Times* office announced the arrival of the schooner *Ethel B. Jacobs*, Capt. Solomon Jacobs, with 600 barrels of mackerel, half large and half medium. This startler is followed a few minutes later by a dispatch from the skipper stating that she has 400 barrels, all large. Whichever is right, it is good news either way, and makes the fourth trip of the season for Captain Jacobs, and should he get a good price for the trip he will still be high line.

Close on the heel of this good news comes another telegram from New York announcing the arrival of the schooner *Lucille*, Capt. Martin Welch, with 200 barrels of bloater mackerel, which are selling for 15 cents apiece. Close following this news came still another telegram announcing the arrival of schooner *Hustler*, Capt. Charles T. Keene, with 80 barrels of large mackerel. Schooner *Braganza*, Capt. William Corkum, also arrived at New York this morning with 100 barrels of fresh mackerel, selling at 6 cents apiece.

Dispatches have also been received stating that the schooner *Lottie Gardner* is also at New York with 80 barrels large mackerel, and schooner *Agnes E. Downes* with 200 barrels large mackerel.

The *Haskins* took her fish off Barnegat. The fish of schooners *Marguerite Haskins* and *Lucille* run from 75 to 80 mackerel to a barrel.

A special dispatch to the *Times* this morning from Philadelphia announces the arrival of schooner *Mariner*, Capt. Joshua Stanley, of this port, with a big trip, fully 350 barrels of medium mackerel, which are selling at 6 cents apiece.

It has been many years since such trips have been taken south as those landed by schooners *Marguerite Haskins*, *Ethel B. Jacobs*, and *Mariner*.

On the 10th there were 19 arrivals at New York, consisting of 2,047 barrels, or 292,000 fish, mostly medium-sized, selling at from 3½ to 14 cents each, the gross value being $15,171. This was the largest number of vessels to arrive on any one day, although the fares averaged smaller than on certain other days.

As the time approached for fitting out for the Cape Shore fishery and the vessels started for their home ports, some of them fell in with schools of mackerel and made small catches, which were landed fresh at Newport, Boston, and Gloucester between May 13 and 19. During the third week in May there were also a few small cargoes of large and medium fish taken to New York, 5 vessels arriving on the 20th with fish that sold for 20 cents each. The final fares of the season were landed at New York on the 24th; these consisted of 2,900 large fish, which brought 22 cents each.

The total yield of fresh fish in the 1897 southern fishery was 11,623 barrels, containing 1,491,255 fish, with a market value of $107,242.

The number of vessels that took fish was 58, or 69 per cent. Twenty-four vessels landed one fare each, 24 secured 2 fares each, 3 took 3 fares each, 5 brought in 4 fares each, while 1 obtained 5 fares and another 6 fares.

Considering the entire fleet, the average catch per vessel was 138 barrels, or 17,753 fish, valued at $1,277, while for those which landed fares the average catch was 200 barrels, valued at $1,849.

Eleven vessels salted the whole or a part of their southern catch; the largest quantity salted by any one vessel was 100 barrels, and the aggregate amount of mackerel thus prepared was 473 barrels, having a value of $2,838.

The fishing in the sixth season after the expiration of the close-time law was almost as disappointing as in any of the preceding years, the catch in fact being smaller than in any season since 1894. The 1898 fleet numbered 44 sail, of which 33 vessels hailed from Gloucester, 3 from Provincetown, 2 from Boston, 2 from Chatham, 2 from Boothbay, 1 from Portland, and 1 from North Haven. The first vessel to start south was the schooner *Kearsarge*, of Gloucester, which sailed March 21; this was followed the next day by the *Ethel B. Jacobs*, and by the end of the month quite a number of vessels had sailed. An interesting feature was that two of the smaller vessels were fitted with gill nets instead of purse seines.

The first fish were caught by the schooner *Ethel B. Jacobs* off Body Island, 70 miles south of Cape Henry, Virginia. The fare was landed at New York on March 29, and consisted of 100 barrels, containing 8,300 fish, averaging 1¼ pounds, which brought 35 cents each, $2,900 being realized on the trip. Subsequent events showed that only the opening of the season was auspicious.

No other fares were brought in until April 12, when the schooner *Lena and Maud*, of Gloucester, landed nearly 20,000 large mackerel at New York, which sold for 20 to 25 cents apiece; these were caught in latitude 37° 50′. Ten days later the schooners *Lizzie M. Center* and *Carrie E. Phillips*, of Gloucester, took 23,000 large and medium mackerel to New York; these brought 25 and 15 cents each, respectively. Only 2 other fares were received at New York during the month. On the 25th the schooner *Lizzie Maud*, of Gloucester, landed 25 barrels of large and medium fish, which sold at the prices last quoted; and on the 27th the schooner *Lucille*, of Gloucester, discharged 100 barrels of medium-sized fish, which were disposed of at 15 cents each. The schooners *Flora L. Nickerson* of Boothbay and *Elsie M. Smith* of Gloucester took fares to Philadelphia on April 28 and 29, respectively, each vessel having about 6,000 fish, mostly medium, which sold at about 15 cents each; these mackerel were caught off the Delaware Breakwater.

During May, 10 fares of mackerel, aggregating 225 barrels, were landed at New York, the gill-netters *W. B. Keen* and *N. A. Rowe* taking in a number of small fares, aggregating about 15,000 fish. The other vessels getting fish were the *Marguerite Haskins* and the *Hattie M. Graham*, both of Gloucester, which together landed 4,000 large and medium mackerel on the 16th and 18th.

The yield in the southern fishery of 1898 was 948 barrels, representing about 102,545 fish, valued at $19,764. The average catch of the vessels engaged was 21 barrels, or 2,330 fish, worth $449, and for those schooners fortunate enough to take any fish the average was 79 barrels, or 8,545 fish, valued at $1,647. Thirty-two vessels took no mackerel whatever, but practically all of those which had fares paid expenses and some of them realized comparatively large sums. The prices were unusually good throughout the season, ranging from 12 to 35 cents apiece, on account of the scarcity and large size of the mackerel.

It thus appears that during the six years which have elapsed since the resumption of the southern spring mackerel fishery, after its five years' suspension by Congressional action, the aggregate catch of fresh mackerel has been 18,396 barrels, representing about 2,393,000 fish, having a value of $215,028. The average annual yield was 3,066 barrels, valued at $35,838; the average annual catch per vessel engaged was 58 barrels, valued at $682; and the average number of barrels per trip was 69 barrels.

FURTHER LEGISLATION FOR THE MACKEREL FISHERY.

Should the present unprecedentedly long period of scarcity of mackerel continue, the discussion of further restrictive legislation may be expected. In fact, the abolition of the purse seine, which has never been a popular apparatus with a certain proportion of the non-fishing population and with a small number of commercial fishermen who have continued the older means of capture, has by some been strongly urged for a number of years and seems to be tentatively favored by a growing number of mackerel fishermen. Leaving aside the entire question of the effects of purse-seine fishing on the abundance of mackerel, many fishermen think the industry would be in a more flourishing condition to-day had the primitive, comparatively inexpensive hook-and-line fishing never been discarded for the improved but very expensive modern means.

Personal contact with numbers of the best-informed and most responsible New England fishermen and dealers during recent years has demonstrated the existence among some of them of a more conservative sentiment than they have usually been credited with as to the possibility of influencing the abundance of ocean fishes by overfishing and the desirability of regulating some of the sea fisheries. While few among them entertain the positive belief that legislation will or can do anything for the regeneration of declining ocean fisheries, some think it desirable to test the possible benefits of legislation. The economic success which has attended the efforts of the United States Commission of Fish and Fisheries to increase by artificial means the abundance of such an eminently ocean species as the cod has been a suggestive topic to many persons who originally scouted the idea of the feasibility of such an undertaking, and the question has been propounded by more than one fisherman why the regeneration of the mackerel fishery may not be accomplished by sufficiently extensive fish-cultural operations.*

Should it seem expedient to Congress to again regulate the mackerel fishery, it is to be hoped that the restrictive legislation may be so framed as to afford a sufficient basis for determining the effects on the abundance of the fish sought to be protected. Ten years would seem to be not too long a period for the operation of a close-time law, as the beneficial results of restriction, if any occurred, would probably be too insignificant to appreciate in a shorter time. A question of even greater importance than the number of years to be embraced is the length of time in each year when the mackerel will be undisturbed. It was urged at the time of the consideration of the subject in 1885–1887 that the proposed law would afford only incomplete protection to fish prior to the spawning season. It seems probable that, as a rule, a large proportion of the mackerel which come on our coast spawn after the 1st of June.

Should Congress be solicited to renew legislation for this fishery, therefore, cognizance should be taken of these facts in order to secure such action as will best determine the utility of legislation for the ocean fisheries.

*In an article published in the Report of the U. S. Fish Commission for 1898, Dr. J. Percy Moore has pointed out the services which the mackerel fishermen may render to fish-culture by fertilizing the eggs and returning them to the sea when schools of ripe fish are caught in purse seines.

ALUTERA MONOCEROS (OSBECK)

A. Hoen & Co. lith. Baltimore.

Contributions from the Biological Laboratory of the U. S. Fish Commission, Woods Hole, Massachusetts.

NOTICE OF A FILEFISH NEW TO THE FAUNA OF THE UNITED STATES.

By HUGH M. SMITH.

On August 22, 1898, there was taken at Woods Hole, Mass., a small filefish of the genus *Alutera*, which represents a species heretofore not recorded from the coast of the United States. The specimen was obtained by Mr. Vinal N. Edwards, a well-known collector of the United States Fish Commission, to whose activity a number of other additions to the fish fauna of the Atlantic seaboard of the United States have been due. The fish was undoubtedly a straggler from the West Indies, like so many others stranded at Woods Hole by the agency of the Gulf Stream. Active search was made for other specimens, but without success.

It was seen that the specimen was apparently referable to *Alutera monoceros*, a widely distributed filefish of the Indo-Pacific Ocean, but as none of the museums in the United States had examples of that fish, and as the published descriptions and plates did not strictly apply, the status of the Woods Hole fish could not at first be satisfactorily determined. Recently, however, through the courtesy of Dr. G. A. Boulenger, of the British Museum, the Fish Commission has been supplied with a specimen of *Alutera monoceros* from the East Indies, and it has been possible to establish the identity of the fish in question.

The following detailed description of the specimen under consideration is presented because it has features which have not been noted in other descriptions of the species. The form and life colors of the fish are accurately shown in the accompanying plate, which represents the natural size of the specimen and is based on a drawing made under the direction of Dr. H. C. Bumpus while it was still alive:

Total length of specimen, 145 millimeters; length to base of caudal, 120 millimeters. Body very much compressed, deeper than in the common filefish (*A. schoepfii*) of the same length, its greatest depth contained 2.4 times in length to base of caudal. Head, measured from anterior end of branchial opening, contained 4 times in body length. Snout short, somewhat produced, the lower jaw slightly projecting, the muzzle rounded. Eye 0.25 length of head and slightly less than supraorbital space. Posterior end of gill-opening under posterior edge of pupil; length of branchial slit 1.4 times diameter of eye. Profile from dorsal spine to a point on level with pupil convex, upper side of snout straight. Between dorsal spine and beginning of dorsal fin is a slight depression. The ventral surface, from a point near the mouth to a point slightly in advance of anal fin, presents a well-marked protuberance with an irregular wavy outline. Between this protuberance and the anal fin is a distinct notch.

Dorsal rays 50, anal rays 52; both fins very low, their height anteriorly but slightly greater than diameter of eye, gradually becoming lower posteriorly. Dorsal spine slender, slightly curved backward, inserted directly above pupil, twice diameter of eye, and contained 3.5 times in greatest body depth.

The dorsal spine is thickly beset with different-sized spinules in definite series; on each edge of a shallow groove on the posterior surface of the spine there is a series of stout retrorse curved spinules; on front of spine are similar spinules arranged alternately in two series; on each lateral surface of spine, between the anterior and posterior rows of spinules, is an irregular row of much smaller, more numerous sharp spinules having a tendency to turn upward; other minute spinules, irregularly disposed with small bare spaces between, roughen the sides of spine.

Distance from spine to soft dorsal is .85 distance to end of snout. The soft dorsal originates further back than the anal, and its first ray is nearer base of caudal than it is to end of snout. Pectoral rounded, very short, less than diameter of eye, its origin under pupil. Ventral spine absent. Caudal rather short, its length less than that of head; posterior margin evenly rounded when spread. Caudal peduncle slender, its width 1.5 times diameter of eye. Skin velvety to the touch.

Color dull bluish-gray above, becoming yellowish-white on sides and whitish below. Entire body and head covered by well-defined dull-blackish marks of various shapes, some being annular, some vermiculate, and some rounded, elongated, or curved blotches; these are, for the most part, larger than the eye. Dorsal and anal fins pale yellow, pectoral fins colorless. Dorsal spine blackish, with a white filamentous tip; the membrane connected with spine plumbeous. Caudal bluish-gray, with four black crossbars; posterior margin of fin whitish. Iris dark.

The species bears no striking resemblance to any other filefish recorded from American waters. Besides the characteristic markings, it presents morphological features which enable one to readily identify it. From the common long-tailed filefish (*A. schoepfii* of Walbaum) found along the entire Atlantic coast of the United States south of Cape Cod, it may be easily distinguished by its less elongated form, shorter caudal peduncle and fin, more prominent abdomen, more obtuse and thicker snout, fewer dorsal and anal rays (36 and 38, respectively, in *schoepfii*), etc. It differs in about the same particulars from the "long mingo" (*A. punctata* Agassiz), which ranges from the West Indies to Brazil, replacing *A. schoepfii* in those waters; and it may be separated from Catesby's "unicorn fish of the Bahamas" and Parra's "lija trompa" of Cuba (now identified with Osbeck's *Balistes scripta* from Asia) by its abdominal protuberance, shorter body and head, less pointed snout, much smaller dorsal spine, and shorter tail.

The specimen from the British Museum was collected at Manado, in the northern part of the island of Celebes. Its total length is 145 mm., the same as the Woods Hole specimen, and its general resemblance to the latter is close, but the Asiatic specimen has a more convex superior profile of head, a much less marked ventral convexity and dorsal depression, and stronger spinules on the dorsal spine. The colors are much faded, but the traces of markings which remain suggest the same pattern of coloration shown in the Massachusetts fish.

In 1757 Osbeck (in Reise nach China) described a filefish from Asiatic waters under the name *Balistes monoceros*, which name was reproduced in the tenth edition of Linnæus' Systema Natura (1758). The synonymy of the fish has been quite varied; under different names it has been recorded from Asiatic and African waters* by Gronow, Gmelin, Walbaum, Freminville, Lesson, Temminck & Schlegel, Bleeker, Hollard, and others.

Recently Jordan & Evermann have put this fish in the genus *Alutera* and have given it a place in the American fauna on the assumption that a fish recorded from

*The known range of this species in the Eastern Hemisphere is from the northern coast of Asia to the middle of the east coast of Africa. It is recorded from Japan, China, Malaysia, India, and Zanzibar, and is perhaps most common in the East Indian archipelago.

Cuba by Parra in 1787, and technically described from that island by Poey in 1863, is the same as the Old World species. On this point these authors say:

The American species seems to be identical with the East Indian *Alutera monoceros*. Should differences appear on comparison of specimens, the former should apparently stand as *Alutera guntheriana*, Poey.—(Fishes of North and Middle America, Bulletin 47, U. S. National Museum, 1898.)

Unfortunately, no specimens of this fish from West Indian waters are known to be preserved, and it is doubtful if any examples are now extant, either in America or Europe, Poey's description being based primarily on a drawing and the whereabouts of his type being unknown. As will subsequently appear, the description of Poey fails in some respects to accurately fit the Old World fish, and quite possibly applies to a distinct species. Should it hereafter be shown that the two are identical, the Woods Hole specimen will be interesting in that it is the only known example taken in the Atlantic since Poey's time, and possibly the only one extant in collections.

It will be observed that the following original description of this fish, as contained in the English translation of Osbeck's work, is based on specimens of the same size as the Woods Hole fish. The only clue to the general form of this species is given indirectly under the head of *Balistes scriptus*, which is said to be "a fish equal in size and appearance to the *Balistes monoceros*, but marked over the whole body, as it were, with blue letters of an Eastern language."

Balistes monoceros is a species of fish which looks like a flounder at a distance and has almost the same taste, but is not so fat. The fish was half a foot long and its body covered with a dark-gray rough skin. We caught several with a hook, and this afforded me an opportunity of describing them.

On each side is a spiracle, and next to it, within the skin, two transversal bones; the first dorsal fin, near the eyes, consists of a reversed brittle bone, which is armed with little hooks; it is the length of a finger's breadth and a little longer than the other fins; the second dorsal fin has 47 rays; the pectoral fins are the least; each has 13 rays; the ventral fins are wanting; in their stead a long bone under the skin; the anal fin is opposite to the second dorsal fin and has 51 rays; the tail has 12 ramose rays; the mouth is oblong and narrow; the lower jaw is somewhat longer than the upper; on each side of it stand three pointed, broad teeth, connected together below, of which the middlemost is split; the lips are movable.—(A voyage to China and the East Indies. By Peter Osbeck. Translated from the German by John Reinhold Forster. London, 1771.)

Later authors, in writing of *A. monoceros* or of the various fishes which have been referred to the synonymy of that species, have so modified and extended the original description that the characters of the species are now much involved. Even conceding to *A. monoceros* a wide range of variation in form and color, it seems possible that several oriental species are included under that name, if differences shown in published descriptions and plates can be relied on. Quotations might be made from numerous works to show the discrepancies in the descriptions of this species, assuming them to apply to the same fish, but a few references will suffice.

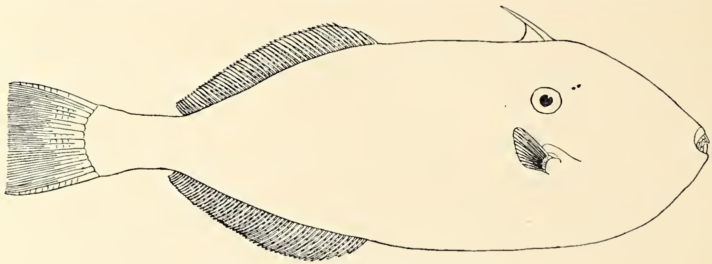
In the ichthyological part of "Voyage of the Sulphur," Richardson describes this fish from China and New Guinea under the name *Aleuteres berardi* Lesson, as follows:

Dorsal 1, 48; anal, 50. The skin of this species looks delicate to the eye, and is softish to the touch, but when viewed through a lens it is seen to be crowded by little bluntish points finer than in the other species [*Aleuteres lævis*]. The dorsal spine is long, and being slender, is easily mutilated, as was the case with the individual from which our figure was taken. Mr. Reeves's drawing does not show the pale roundish marks exhibited in Lesson's figure, and no traces of this can be detected in Sir Edward Belcher's specimen, which also agrees with the Chinese painting, showing a greater prominence of the pelvic bone near the chin. The ground color of the painting is brownish-purple red, with some crimson and purple touches on the temples and face. Length, 15½ inches.

Bleeker ("Atlas Ichthyologique des Indes Orientales Néêrlandaises") describes and figures *Aluteres monoceros* with a long, curved, slender, serrated dorsal spine, about half as long as body is deep; the body uniformly pale yellow, dark green, or greenish yellow, occasionally with irregular, diffuse brown spots; the fins yellow. A species of similar form and color, but with a short, smooth dorsal spine, is shown by Temminck & Schlegel in their "Fauna Japonica"; this fish, which they call *Aluteria cinerea*, is very generally referred to the synonomy of *A. monoceros*.

Following is Dr. Günther's description of this species (under the name *Monacanthus monoceros*), based on nine specimens in the British Museum from Asia and Africa:

D. 48, A. 50. Vertebræ 7–13. Skin finely velvety. Body oblong, its depth being two-fifths or less than two-fifths of the total length (without caudal). Snout produced, with the upper profile convex. Dorsal spine feeble, above the middle of the orbit. Part of the gill-opening in advance of, pectoral fin below, the orbit. Caudal fin subtruncate, much shorter than the head; dorsal and anal fins low. Ventral spine, none. Uniform brownish.—(Catalogue Fishes British Museum, VIII, p. 251.)



Alutera monoceros, from India. After Day.

Day, in his "Fishes of India," figures a specimen of this species 15 inches long from the Andaman Islands; an outline copy of this plate is herewith shown, and the description of the species is as follows:

Dorsal, $1\frac{46}{48}$. Anal, $\frac{48}{53}$. Length of head abont 4, height of body from $2\frac{3}{4}$ to $3\frac{1}{3}$ in the total body length. Eyes rather small, situated between the npper end of gill-opening and first dorsal fin. Body oblong, snout moderately produced with its upper profile convex. Vertical fins low; dorsal spine weak, rough but barbless. Colors brownish or blackish, the fins yellow.

The most recent description of this species is that of Jordan & Evermann, who embody Günther's description and amplify as follows (loc. cit.):

Depth $2\frac{1}{2}$ to $2\frac{3}{4}$. D. I, 48; A. 50; vertebræ 7 + 13. Body oblong; snout produced, with upper profile convex. Dorsal spine slender, short, not one-half longer than eye, above middle of orbit. Lower part of gill-opening in advance of eye; pectoral fin below posterior part of orbit. Caudal fin subtruncate, or double concave, with acute angles; much shorter than head, and shorter than its own peduncle; dorsal and anal fins low; ventral spine, none. Skin finely velvety. Color uniform brownish-olive, or grayish, finely mottled with darker, the region below dorsal with faint dusky spots amid paler reticulations.

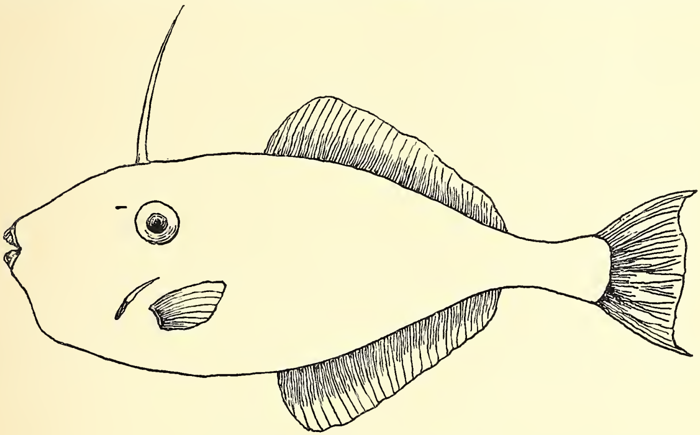
It may not be without interest now to refer to Parra's and Poey's accounts of the Cuban fish that has been supposed to be identical with the East Indian form. Parra describes and figures the species in his rare and interesting work entitled "Descripcion de Diferentes Piezas de Historia Natural" (1787), which had the distinction of being one of the earliest books published in Havana and of containing the first copper-

plates engraved in Cuba. After describing the long-snouted species of filefish locally known as "lija trompa," or trumpet-fish, which Poey in 1863 described as *Alutera picturata* and which has by other writers been identified with *Alutera scripta* (Osbeck), Parra gives the following description of "lija barbuda":

There is only this difference from the foregoing, that in place of the trumpet it has below the mouth an enlargement in the shape of a beard, and that the head for its whole length is much larger; that the spine located between the eyes is much longer, and that throughout its length it is thinner. The tail is much shorter, as if cut vertically. The color is generally ashy, without any marking.

A facsimile of Parra's figure is herewith presented.

In reviewing the ichthyological part of Parra's work, Poey has accorded high praise to that author in a paper entitled "Enumeration of the fish described and



Parra's "*lija barbuda*," from Havana.

figured by Parra, scientifically named by Felipe Poey," from which the following extract is made:

The work cites no authors, contains no classification, no scientific terms, and the names are all popular ones. It is easily seen that Parra has studied no books except the great book of nature; by his own natural gifts he has succeeded in describing and figuring objects as correctly as his cotemporaries, and even surpasses Bloch in the exactness of his figures. Cuvier says: "It is one of the most useful works in the study of the fishes of the Gulf of Mexico, not only on account of the text, but also on account of the very exact figures representing them." Parra does not omit describing the teeth of the jaws, the asperities of the scales, nor even the spinous rays of the dorsal fin and the furrow in which they can be hidden. He dwells more especially on the number and peculiarities of the fins, and he can not be reproached for omitting in his descriptions details that are shown in his figures. He observes, very properly, that the colors are less important than the rest of the organism, for he only treats of them last. To be sure, he neglects the palatine teeth, the spines of the operculum, the denticulations of the preoperculum, the exact number of the spinous and soft rays; but this is not surprising in one who preceded Cuvier & Valenciennes, and who probably was not acquainted with the works of Artedi, Linnæus, or Gronovius.—(Proc. Acad. Sciences Phil., vol. XV, pp. 174–180, 1863.)

After referring to the writings of Bloch, Cuvier, Valenciennes, Guichenot, Hollard, and others who had cited Parra's work, Poey says:

As for myself, it will be seen on examination how much I have added to and corrected all that has hitherto been done. The opinion of authors has not been given without care. I have compared their descriptions with those of Parra, and with actual specimens, having the advantage of working in Havana and of knowing the fish by their popular names.

In considering the fish now in question, Poey refers to previous attempts to assign Parra's "lija barbuda" to some one of the known species, and cites Bloch,* who doubtfully identified it as "*Balistes monoceros* L.," and Hollard,† who referred it to his (Hollard's) *Aluterus anginosus* from the East Indies (now also placed in the synonymy of *A. monoceros*). Poey himself, however, regarded the fish as belonging to his species, *Alutera guntheriana*, which he described as follows in the same journal:

Individual described, 510 millimeters. It is remarkable at first glance for a protuberance which belongs rather to the throat than the chin. Its pelvic region forms a curve, which follows regularly the skin of the abdomen. The body is very compressed. The mouth is small, the snout obtuse. Its depth is one-third its total length; the head, taken from the inferior angle of the branchial opening, is comprised in it a little more than 5 times. The eye is separated 3 times its diameter from the median dorsal line and 6 times from the extremity of the snout. The branchial slit is very oblique, and its anterior half projects beyond the orbit. The nostrils have two apertures close together, placed one before the other, rather near the eye. From what my drawing, by the profile, permits one to believe, the teeth would be as in the preceding species. The dorsal spine is slender, not toothed, terminating in a fine point, almost straight, turned backwards; its groove is short; its height is two-thirds the height of the body underneath—that is, almost two-thirds of the greatest height of the body; its point of attachment is above or a little in advance of the anterior side of the eye. The line of the back rises somewhat in a straight line from this point. The second dorsal is as much distant from the spine as the spine is from the snout. The anal is almost as much advanced, very little more extended. These two fins are a little elevated in front ($1\frac{3}{4}$ the diameter of the eye) and decrease gradually behind, where they present only a third or a fourth of the anterior height. The pectoral is rounded. The caudal is at least twice as high as long; it is divided vertically in such a manner as to have its posterior edge sinuous—that is, convex in the middle and ending in two sharp points, which advance a little less than the convexity. D. 1+48; A. 51; P. 14; C. 12. I have not the skin under my observation, but my drawing represents the scales formed of several microscopic grains which have not yet been viewed under the magnifying glass; they are soft to the touch. The color is plumbeous, but the throat and underneath the belly are whitish. There are on the nape and along the back little brown spots. The sides are adorned with very different markings, sometimes circular, sometimes elongated. These marks disappear very soon; that is why Parra has not represented them in his lija barbuda, which is the actual species. The eye is golden, with some dark waves. The fins are orange, except the caudal, which is a very deep lead color.

This could not be the *Aluterus anginosus* of M. Hollard, who has seen many specimens of it in the Museum of Paris, all from the East Indies. I do not find it cited in the *Enumeratio Piscium* of Dr. Bleeker. The individuals described by M. Hollard (Ann. des Sc. Nat., 4th series, vol. 4, p. 11) have the dorsal spine short and the caudal rounded. D. 49; A. 53.—(Descriptions des poissons nouvelles ou peu connues. Loc. cit., pp. 184, 185. Translation.)

The accompanying illustrations and foregoing descriptions indicate the marked differences between the Cuban fish and the Woods Hole specimen. Furthermore, Poey's account applies to a fish that seems to differ from the variously described Old World examples of *monoceros*. Therefore *A. guntheriana* Poey should perhaps be recognized as a valid species until an examination of specimens from the type locality warrants a different course.

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* Systema Ichthyologiæ, 1801. † Annales des Sciences Naturelles, 1855.

THE PEARLY FRESH-WATER MUSSELS OF THE UNITED STATES; THEIR HABITS, ENEMIES, AND DISEASES, WITH SUGGESTIONS FOR THEIR PROTECTION.

By CHARLES T. SIMPSON.

The *Naiades*, or pearly fresh-water mussels, have a distribution throughout the lakes and streams of the globe, not only on the continents, but also on all the larger and some of the smaller islands. They exist in countless numbers, especially in the United States, which seems to be the metropolis of these forms, both as to species and individuals. Probably over 600 valid species are now living in North America, and fully three-fourths of these are found in the Mississippi drainage area and the streams which fall into the Gulf of Mexico from the north. Many of these mussels here attain a great size. Some are covered with knobs or pustules, or have peculiar and striking forms, while others are brilliant with radiating stripes or beautiful and intricate patterns of coloring. The interiors of many of these species are very rich, the colors varying from almost blackish-purple to coppery, glowing red, pink, salmon, straw-color, and silvery white.

Within the past few years a great deal of interest has been aroused in the United States in regard to these mussels. Thousands of persons have given more or less attention to hunting them for their pearls, which often have a high money value, and others have gone quite extensively into the business of manufacturing the shells into buttons and various ornaments. So great has been the drain on them that in many places they have become very scarce, and are even threatened with extinction. Mr. George F. Kunz, the well-known gem and pearl expert, has just published a paper on the fresh-water pearls and pearl fisheries,* containing an immense amount of useful and accurate information. In the present paper the subject of the pearly mussels will be treated more from a biological standpoint.

The species inhabiting the Mississippi drainage area extend their range on the south through all the streams of the United States flowing into the Gulf of Mexico, and to some extent into Mexico; on the north some of them range nearly to the Arctic Ocean, and from the Rocky Mountains, which are a barrier on the west, throughout a considerable part of the St. Lawrence drainage area. On the Atlantic coast from the St. Lawrence to the Gulf of Mexico the streams and lakes are filled with mussels, usually simple in form and dull in color and quite different from those of the Mississippi region. Only a very few species are found in the waters draining into the Pacific.

The shells of the pearly mussels consist of two convex valves, which fit together and inclose the animals. These valves are covered with a coating of somewhat leathery matter called the epidermis, and are joined together at the upper part or back of the animal by a hard, horny, rather tough and elongated C spring, which has a tendency to throw them open. In front of this spring, which is called the ligament, there are found, on uninjured shells, a couple of slightly corrugated eleva-

* "The fresh-water pearls and pearl fisheries of the United States," U. S. Fish Commission Bulletin for 1897, pp. 373–426, pls. I–XXII.

tions, one on each valve, and opposite; these are called the beaks or umboes, and are the oldest part of the shell. The rounded end of the shell is the front or anterior part, as this is always ahead when the animal is moving, and the pointed end opposite is the hinder or posterior part. In most of the heavier species there are developed interlocking or hinge teeth along the upper inner edge of the shell.

If a living mussel is taken and a thin knife is inserted at the front and hinder ends and a cut made toward the hinge, it will gape and the animal may be examined. A thin veil of soft animal tissue, called the mantle, covers the entire inside of both valves, reaching out to their edges, and joined together at the upper part of the shell. It is fastened to the shell near the border in a slightly indented furrow called the pallial line, and by muscles at the upper part of it. The edge and outside of this mantle throw out a sort of milky liquid, containing carbonate of lime and animal matter, which builds up the shell, thickening it from the inside and adding to it at the edge; the brilliant nacre next to it, a layer of vertical prismatic cells outside this, and over all the protecting epidermis. The mantle is carried between the locking hinge teeth, filling the space between them like a cushion. At each end of the shell inside, near the back, will be found a mass of tough, white, muscular fibers running from valve to valve, which have been cut into by the knife, and these are the powerful adductor muscles by which the animal closes the shell. Some of the *Naiades* have thin shells and no hinge teeth, the *Anodontas*, for example, and these almost invariably live in stagnant or slow-moving water. The *Unios*, the thicker-shelled forms, which have well-developed teeth, live for the most part in

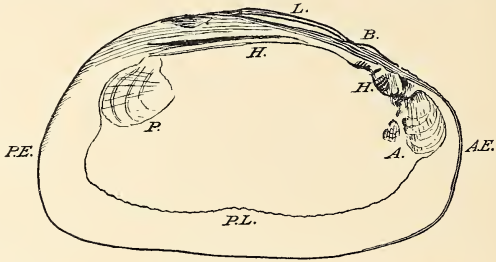


FIG. 1.—Diagram of interior of Unio. B., beak; L., ligament; H. H., hinge; A., anterior adductor scars; P. L., pallial line; A. E., anterior end; P. E., posterior end.

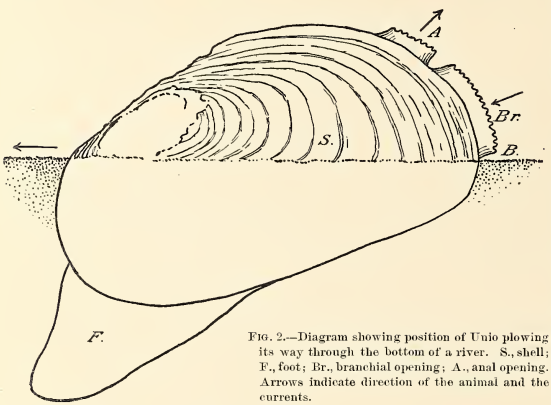


FIG. 2.—Diagram showing position of Unio plowing its way through the bottom of a river. S., shell; F., foot; Br., branchial opening; A., anal opening. Arrows indicate direction of the animal and the currents.

running water. The adductor muscles allow the shell to open but a short distance, so that the teeth always lock, and the mantle cushion swells when they are open and prevents them from slipping. There can be no doubt but that the hinge teeth are developed in the river mussels to prevent the valves of the shell from twisting on each other, which they would be likely to do in swift currents or in time of floods.

The *Anodontas*, living in still water, have thinner shells and do not need any locking teeth. Within the mantle, filling a large part of the shell and hung along the hinge line, is a sort of bag which contains the vital organs and is called the abdominal sac. This extends below and in front into a tough sort of hatchet or tongue shaped organ that is pushed out of the shell when the animal moves, and by expanding and contracting and moving forward and backward the whole is plowed along in the sandy or muddy bottom, leaving a little furrow. This is called the foot. Up under the forward adductor muscle is an opening into the abdominal sac called the mouth. It is carried through, as a tube, much folded and bent back on itself, the intestinal canal, and finally empties near the posterior adductor. Surrounding this canal, as it passes along the back of the animal, is a sort of heart, which beats regularly. Fastened to the mantle and the top of the abdominal sac in some cases, hanging down between the two, and reaching from the hinder end of the shell well toward the front, are, on each side of this sac, two curtains or flaps of the most daintily beautiful and delicate texture, and these are organs of vital importance to the mussels. They are the gills or branchiæ, and answer to the gills of the fishes or the lungs of land animals. Just in front of them and near the mouth, on either side of the abdominal sac and under the mantle, is another pair of smaller flaps, somewhat triangular in our species, and extending behind, which are called the palpi, and when the animal is feeding these are constantly in motion. At the hinder part of the animal the mantle, which is not fastened together here in our species, shows two small openings, one above the other, by having its edges pressed close together between and below these openings. One or both of these is fringed, and when the animal is feeding these fringes may be seen beautifully expanded between the hinder parts of the shell. The upper is the anal and the lower the branchial opening.

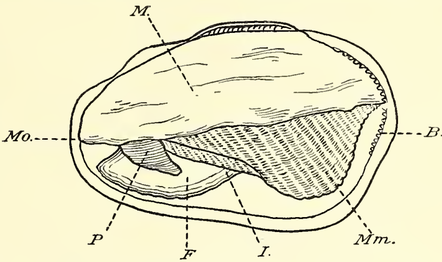


Fig. 3.—Anatomy of female *Lampsilis luteolus*. M., mantle folded back showing below; P., labial palpi; F., foot; I., inner gill; Mm., outer gill with the hinder part transformed into a marsupium; B., branchial opening; Mo., position of mouth.

When the animal feeds, the front part of the shell is usually buried in the mud or sand, leaving the hinder part to project free into the water; the shell is opened, the branchial and anal openings are spread, the palpi forward begin a rapid flapping, which draws in a current of pure water through the branchial opening. This passes through the gills, aerating the blood, then into the mouth and along through the intestinal canal, carrying in confervæ and microscopic forms of life which serve as food for the animal, and on out at the anal opening.

The sexual system consists of racemose glands within the abdominal sac, the male and female organs being so much alike that only a very clever expert can tell them apart. The sexes are generally, though not always, separate. Usually one animal is a male and another a female, and this is always the case among the more highly organized *Naiades*, but it has been pretty well proved that in some cases individuals are provided with both sets of organs. It is held by some students that certain of these mussels may change from one sex to the other, but this has not been proved. It is not certainly known yet how impregnation takes place, but it is supposed that the male ejects the spermatozoa into the water, where it is taken up by the female and passed into the ovaries. Within the ovaries the eggs are developed, and when they reach a certain stage they pass down through an opening into the gills. Here they undergo still further changes, developing a small bivalve shell, but very different in form from what it is when mature. Later on they are thrown out of the ovisacs of the transformed gill and fall to the bottom of the stream or pond.

Each little mussel is usually provided with one or more pairs of spines or hooks on its base, and when thrown out it lays on its back with the valves opened very wide. A long filament floats up from the minute clam, which in some way can attach itself to the fins, gills, or scales of fishes which come in contact with it. When such a connection is made, the little mussel rapidly draws itself up and snaps the valves on to the gill, scale, or fin, burying the hooks in it. This irritates the fish, causing it to throw out a fleshy substance, which incloses the embryo naiad just as an oak leaf covers up the egg of the gall insect that is laid in it. This cyst is air and water tight, and in it the little prisoner remains for a period of some seventy days, growing but little, though developing its organs. It is easy to see that during the time of its encystment it may be carried many miles away from the spot in which it left its mother's gills, and when it finally works out and drops to the bottom it is ready to found a new naiad colony.

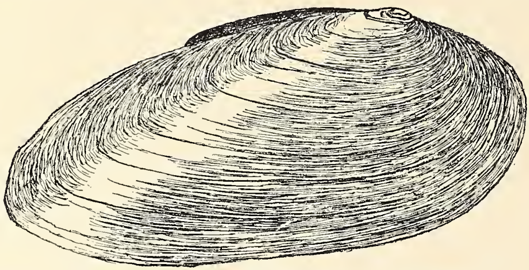


FIG. 4.—*Unio gibbosus* Barnes. A species in which the male and female shells are alike. This has young filling the outer gills only.

It has often been a source of wonder to naturalists how a given species of fresh-water mussel can inhabit a number of independent streams flowing into the sea, for it is a well-known fact that the *Naiades* can not live in salt water or even that which is more than very slightly brackish. Yet such is often the case. *Unio complanatus* inhabits every stream emptying into the Atlantic from Labrador to Savannah. And *Anodonta californiensis* is met with in a great number of rivers flowing into the Pacific. Now, I conceive that it would be easily possible for these embryos to attach themselves to the marine fishes which go up the rivers that empty into the sea and into the fresh water to spawn; that in some cases—rarely perhaps—these fish, not finding conditions favorable for spawning in the first stream entered, might return to the sea

and ascend a near-by stream, carrying with them the encysted mussels, which might be dropped in the second stream entered. Of course, when thus inclosed in the protecting cyst they could be carried through the sea without injury.

The pearly mussels live in a great variety of conditions. Most of them are found in shallow water, but certain forms live at considerable depths. Arnould Locard is authority for the statement that *Unio prosaerus* lives down to 50, 100, or even 200 metres in Lake Tiberias.* Others live at great depths in the African Lake Tanganyika. In Florida I have seen myriads of *Unio tortivus* buried among the fibrous roots of trees, and in the muddy, sandy banks just below the surface of the water, *Lampsilis anodontoides* of our western rivers sometimes burrows to the depth of a foot or more, and the curious *Anodonta angulata* of California and Oregon buries itself in hard clay in rapid water, with the wide posterior end down stream, allowing the sharp angle along this part of the shell to just come to the surface of the clay, so that it presents little resistance to the current. Our curious *Margaritana dehiscens* has a greatly elongated foot, and burrows deeply in the mud at the bottom of the streams, and the same is true of the South American *Mycetopoda* and the Chinese *Solenaia*. These forms probably do not migrate under any ordinary circumstances. I have reason to believe that the species which plow furrows on the bottoms of ponds and streams often migrate.

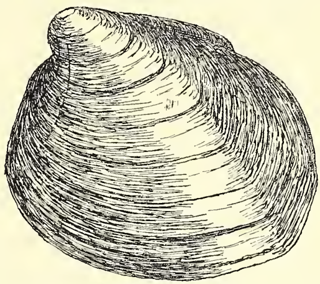


Fig. 5.—*Quadrula ebena* Lea. Niggerhead of the button manufacturers. Young shell taken in its tenth year. This has young in all four leaves of the branchiæ.

Ordinarily, the pearly fresh-water mussels die in a short time if taken out of the water—in 24 to 48 hours, as a rule. I have had thousands of specimens taken alive, packed tightly in boxes, and sent to me at Washington by mail or express from various parts of the country, from as far as Texas, Dakota, Florida, or Maine. Perhaps half of these reached me in a living condition when they came through promptly. Generally they die when exposed a few hours in the sun. Once when collecting in Indian Territory I came upon an artificial pond at McAlester which had been drained only a few days, and all over the soft bottom the water stood in puddles. Thousands of *Unio subrostratus* and *tetralasmus* were lying dead in the mud, and the odor was so sickening that I could scarcely collect them. Yet, under certain circumstances, both species will live buried in dried mud for a long time. Hon. J. D. Mitchell, of Victoria, Tex., kept specimens of *tetralasmus* alive in a dry room for many months.

In June, 1850, a living pond mussel was sent to Mr. Gray in London, from Australia, which had been out of water more than a year.† In a small stream near Braidentown, Fla., a great colony of *Unio obesus* is established. This stream or drain is in the piney woods, and only runs during some three months in the summer—the rainy season. The rest of the year it is dry, and thousands of these mussels may be found just buried in the sandy banks, or among the flags and rushes of the bottom where there is very little moisture; yet all are healthy. I have laid these mussels out in the sun for months, after which nearly all of them were found to be alive. There can be but little doubt that the specimens which live in perennial water soon

* Arch. d'Hist. Nat. de Lyon, 1883, p. 197. † Woodward's Manual of the Mollusca, 1856, p. 18.

die if removed from it, while those which inhabit streams or ponds that often dry up will live a long time out of water. It is well known that the streams of Australia often go dry, and the smaller ones of the Western States are quite liable to do so.

Some species in rocky streams remain in the crevices of the rocks. In the Big Vermilion River, in Lasalle County, Illinois, a swift rocky stream, I have found living mussels which had been so washed about that nearly all the epidermis was destroyed. The shells in such streams are usually heavier than those from more quiet water.

There are two great and very distinct groups of pearly mussels in the fresh waters of the United States, and several smaller somewhat intermediate ones. In the first the shells of the male and female are essentially alike, and the embryos, before being thrown into the water, fill either the entire outer gills, or, in some cases, all four of them. At this time the marsupium, as the transformed gills may be called, is smooth and pad like. In the second great group the shell of the female shows a decided swelling on the base just behind the middle, and this is absent in the male shell. In the species of this group the embryos are only found in the hinder part of the outer gill, and this part is rounded below, and the ovisacs containing them are separated from each other by a furrow and rounded on the lower end. The latter group contains the more highly organized of our fresh-water mussels.

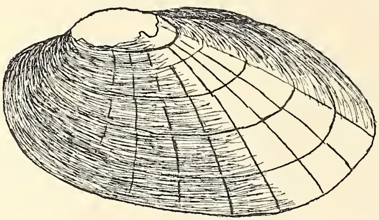


FIG. 6.—*Lampsilis luteolus* Lam. Male. Shell not produced at posterior base.

From all the observations that have been made, it seems that in a majority of cases the species of the first group become impregnated in the fall, carrying the eggs in the ovaries through the winter. In the late winter or early spring they pass into the gills, develop a shell, and are thrown out into the water along up to June. Those of the second group, where the males and females are so different, probably become gravid in the spring or early summer, and have the hinder part of the outer gill full of eggs in the summer or early fall. These rules do not hold absolutely, and some of the species, or even many of them, especially of the more highly organized groups, may breed oftener than once a year under favorable circumstances.

Little is known as to the winter habits of these mussels. It is quite certain that they sometimes burrow into the mud and become almost if not quite dormant, while at other times they are active during the winter. Certain species may be found gravid at different periods of the year; others seem rarely so. I have never seen or heard of a gravid *Unio plicatus* (a common, thick, plicate form of the Mississippi Valley), and I have examined many specimens of *Margaritana margaritifera* taken all through the year, and have never seen any with embryos either in the ovaries or gills.

The number of young contained in the female at a single time is often very great. In the species which carry them only in the hinder part of the outer gills they are far less numerous than in those of the other group. Most of these probably contain from 500 to 1,000 at a time, if fully adult. The species which have the whole outer gills transformed into a marsupium have a far greater number, while those which have all four gills filled contain the most. The common swan mussel of Europe, *Anodonta cygnea*, has been estimated to carry 200,000. A *Glabaris* from Lake Nicaragua, which

I examined, must have had at least a million eggs in its inner gills, and Dr. Isaac Lea made a calculation that a single *Unio multiplicatus*, our largest species, and one which carries the young in all four of the gills, had no less than 6,000,000.

There is ample need for all these young, for from the time of their birth until they die of old age they are constantly beset by enemies and forces that cause their destruction. Even nature herself seems bent on destroying them. Many of them will survive after being frozen, and an instance is on record where an *Anodonta* that was frozen solid while gravid hatched out its young all right on being thawed out; yet millions of them are undoubtedly destroyed by very severe weather. I have seen tens of thousands of empty shells in spring in the Potomac, after a very severe winter, clinging together by the ligament, and in many cases having shreds of flesh still attached to them. These probably did not bury deeply enough or the water might have been unusually low during hard freezing. No doubt those that live in shallow water suffer most from frost, but on two or three occasions I have seen the *Unionidæ* of a region almost exterminated after an uncommonly hard and unfavorable winter.

Dr. James Lewis, an exceedingly able and careful student of North American mollusks, believed that many of our pearly mussels are almost absolutely dormant during the winter. He held that in the summer they make their growth, adding a wide concentric layer to the shell. In winter the growth practically ceases, but the mantle still deposits a slight amount of shelly material and epidermis; but as the shell does not increase in size in winter, these deposits of epidermis form a narrow, dark, concentric line or band around its border. Others have held to the same idea, which is probably a correct one. In many cases these dark resting lines are marked as plainly on the outside of the shell as are those in a section of a tree, and if the theory of Dr. Lewis is correct, we may thus count the age of the clams by the rest periods, as we do that of the forest trees by the annual rings. In some cases these marks are not plain or even visible, and this is especially so with many tropical *Naiades*, which may continue to grow more or less throughout the year. It is possible that those of our northern species which do not show these rest rings or only have faint indications of them may be more or less active through the winter.

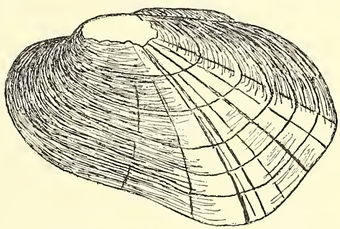


Fig. 7.—*Lampsilis luteolus* Lam. Female. Shell produced at posterior base.

It is hard to tell just at what age these mussels begin to breed, because this no doubt varies with the species, the amount of food, and favorable or unfavorable conditions; but I think it may be stated that it is generally at from three to five years from the embryo in those species which carry the young in the hinder part of the outer gills. Those which have both outer gills filled with young do not begin quite so early, and in the forms where all four gills are filled I do not think they often begin to produce young until they are seven or eight years old. The number of young produced by these young mussels is quite small compared with those of fully adult or old specimens. But if these younger mussels, say from five to nine years of age, could be always thrown promptly back into the water they could at least furnish one, possibly two crops of young, which would go a long way toward keeping up the supply, and really prove little or no loss to anyone. After reaching maturity but little is added to

the size of the shell, though it increases in thickness; hence it is difficult to say how old mussels become, but it is reasonable to believe that many live to be from 15 to 25 years old.

Floods no doubt cause considerable havoc among the *Naiades* on the one hand and unusual droughts on the other. In the former, millions are washed from their beds and often buried deep under mud, sand, or gravel, and destroyed, or are swept out into places where at ordinary times there is no water. River beds are changed, and wide areas densely populated with these forms are transformed into dry land. A letter received from a correspondent a few days ago told of his being in Honduras and seeing a multitude of buzzards congregated together in the valley of a small river. On investigating he found that the stream had changed its course over a long distance during a recent flood, leaving its old bed dry, and in it were vast numbers of decaying Unios. Where droughts dry up streams that are ordinarily perennial myriads of mussels perish.

In many parts of the world, and especially in certain localities of the United States, a large amount of carbonic acid in the water works great damage to the pearly mussels. This is especially true in the Southern States, while the waters of the Upper Mississippi Valley are generally comparatively free from it. No doubt the epidermis is developed in part to protect the shell from the effects of acid, but that upon the beaks, being rather thin and wearing away or becoming broken on account of being older there and more prominent than elsewhere, gives the acid a chance to begin to erode the shell. In many cases it eats down into the heaviest shells until they are seriously injured. The animal attempts to counteract this by adding on layers to the inside of its shell, but any great erosion always produces disease. I have seen some of the heaviest shells of Holston River so eroded that they were shapeless and it was impossible to tell what they were, and in Florida many Unios are destroyed by having holes actually eaten through to the animal.

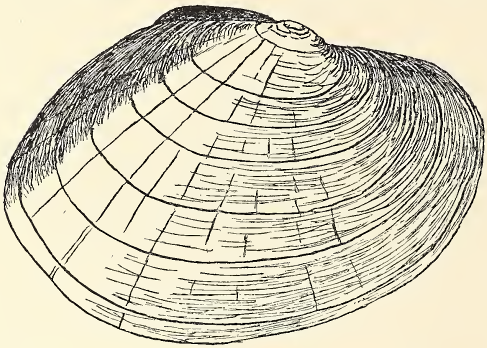


FIG. 8.—*Unio ventricosus* Barnes. Showing rest periods. This specimen was collected in its eighth year.

We do not know anything of the enemies of the *Naiades* when they are first born, but it is quite likely that such do exist. Experiments seem to show that fish avoid the embryos when aware of their presence, but devour the mussels eagerly after they have passed through the encysted state. Raccoons and muskrats prey on them, the latter carrying the shells out in great numbers along the banks of lakes and streams. Many rare shells that are eagerly sought by the collector are thus brought out of deep water, but they are generally weathered or broken when found. Mr. J. B. Upson,

of Rockford, Ill., states that crows carry some of the large species from Rock River to a considerable height in the air and drop them on the rocks, where they are broken, and thus they can feast on the animals.

Many years ago Dr. Isaac Lea bestowed the specific name *salmonia* on an *Anodonta*, which had peculiarly roughened, orange-colored nacre, and which was quite abundant in some parts of New York. Since then a number of other species have been found to occasionally exhibit this peculiar, roughened, blistered nacre, sometimes yellow, salmon, orange, or even a dirty white, and Prof. H. L. Osborn has recently shown in the Zoological Bulletin (vol. I, No. 6, pp. 301–310) that this is the work of a Trematode. The so-called *Anodonta salmonia*, when free from this parasite, is the *Anodonta grandis* of Say. I have seen quantities of mussel shells greatly injured by this pest, and though it may not actually destroy the animals, it unquestionably does great damage.

The question, "Can anything be done to save these mussels?" is a most important one. It is not difficult to enact statutes to protect timber, fish, or wild game; but it is one thing to make laws and another to enforce them. Whatever is furnished by the bounty of nature seems to be the property of the first one getting hold of it. In wanton wastefulness, man has destroyed many millions of acres of our original forest, until now we are forced to go without timber, or plant and raise it; he has swept out of existence much of our wild game, and made the most serious inroads on the fishes. And now it seems as though he must exterminate the *Naiades*. No doubt the settling up of the country, breaking the land, fencing and pasturing every foot of ground, draining out the ponds and marshes, and cutting down the timber indirectly proves destructive to the clams. The water which falls as rain or snow rapidly runs off as disastrous floods at times, and in a short time after the heaviest rains the ground is dry and, consequently, in the summer months many of the streams cease to flow. I remember forty years ago when the larger streams and smaller rivers of northern Illinois were perennial and meandered through thick woods, with here and there deep, quiet pools, and they were filled with fresh-water mussels. To-day they go dry during severe droughts; they are wide-bedded and shallow; their banks are shadeless; the pools have disappeared, and so have the mussels.

Hogs are a great enemy of the *Naiades*, and they not only destroy such as are found on the surface, but root them out from almost any depth. They should be kept away from streams and lakes, especially during low water. I have seen hundreds of acres of river bed during the time of low water completely dug over by hogs, and nothing left of the mussels but broken shells.

The dumpings of manufactories and the sewage of cities turned into rivers are destroying not only the fish but the *Naiades*. In many places below factories or cities the water of the streams is offensively foul and wholly changed in color, so that practically no kind of organic life can exist in it. Along the Potomac and Shenandoah rivers, in the vicinity of Harpers Ferry and above it, are a number of mills which grind wood into a pulp for the manufacture of paper. These throw their sawdust and waste into the streams, and down below, where the water is comparatively quiet, it settles to the bottom, forming great masses of slushy, putrid matter, which is, no doubt, destructive to fish and mussels. The city of Chicago is about to turn its sewage into the Des Plaines River, from which it will be carried into the Illinois River, a stream abounding with the very finest of fresh-water mussels. There can be but little doubt that this great volume of filth and poison will destroy every mussel in both of these streams, and may exert its deleterious influence even on the Mississippi River

below. It is not likely that pearl-hunters or button-makers will ever completely exterminate any of the species. There will always be some individuals left (especially where they are not abundant enough to make it pay to collect) to propagate the race. Fishes also can be depended on to carry the young about and plant them, thus forming new colonies and helping to restock the old ones. But sewage and much of the refuse from manufactories will kill everything downstream. It is to be hoped that some plan may be devised to utilize this waste, otherwise it will be difficult to compel cities and mill-owners to dispose of it in any other way than by turning it into the water-courses.

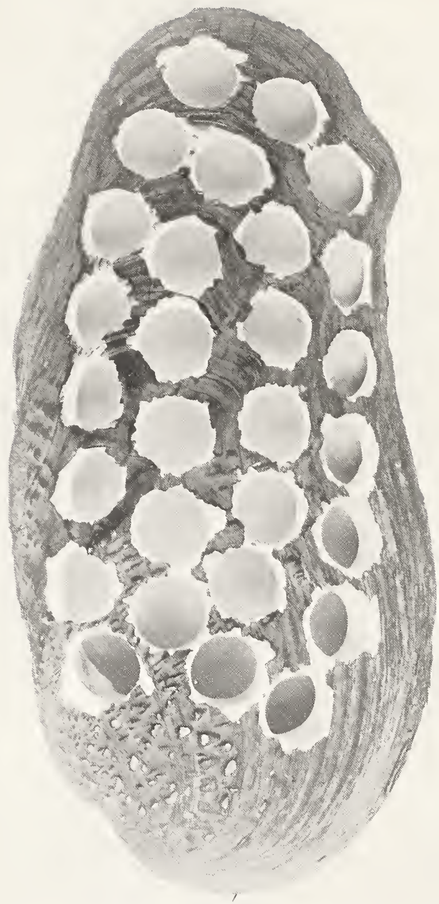
The immense number of mussels taken by pearl-hunters and the manufacturers of buttons and ornaments, generally in the most wanton and wasteful way, is undoubtedly diminishing the supply with great rapidity. In cases where individuals are collecting independently, either for pearls or to sell to manufacturers, it would probably be very difficult to get them to even throw the small mussels back into the water. But manufacturers, who ought to be intelligent enough to understand how rapidly the supply is becoming exhausted, and how much it is to their interest to preserve it, might at least use their influence to have those in their employ attend to this matter, and where corporations or individuals have control of water from which collecting is done they could compel attention to this. No mussel less than four or five years old should be taken by a pearl-hunter or anyone engaged in collecting for a manufacturer. Such young specimens would not furnish pearls of any value, and, as a rule, they are too small to be used with profit for buttons.

Certain regulations might be made in regard to dredging, raking up, and otherwise disturbing the beds of mussels. Mr. J. F. Boepple, president of the principal button factory at Muscatine, Iowa, who has given this subject much attention, believes that the disturbing of the beds at the time when the animals are loaded down with young is a cause of much injury, and he is no doubt right. When the gills are filled with embryos they often protrude when the shell is open, and if disturbed they suddenly close the shell, sometimes cutting off large portions of the ovisacs.

It is doubtful whether any part of the year could be selected for a closed season that would be much better than another part. There is not enough yet known about this matter to give complete data to work upon, but from what I have seen in the examination of many thousands of animals taken throughout a wide range of country, and during the greater part of the year, and the statements of others, it would seem that the process of breeding is going on with some of the *Naiades* all the time.

Something, no doubt, might be done in the way of mussel farming, just as oyster-growing is made profitable. The great mussel shoals on the Tennessee River, reaching from Florence, Ala., for 20 miles up the stream, are literally blocked with mussel shells. I have seen ripples in rivers where one could not step for a mile without treading on a living mussel. Such places, if kept under control and properly worked, ought to prove immensely profitable, and they need never be exhausted or even reduced.

PLATE 65.



LARGE "DEERHORN" (*Tritigonia verrucosa*) FROM WHICH TWENTY-EIGHT ROUGH BLANKS HAVE BEEN CUT. Natural size.

THE MUSSEL FISHERY AND PEARL-BUTTON INDUSTRY OF THE MISSISSIPPI RIVER.

By HUGH M. SMITH.

Although the business of manufacturing buttons from the shells of our native fresh-water mussels is of quite recent origin, it has already attained comparatively large proportions and seems destined to have still further growth. The fear is entertained, however, that, through indiscriminate methods, the supply of mussels may be so seriously reduced that the continuance of the fishery and the dependent manufacturing may be imperiled. The possibility of the early exhaustion of the mussel beds in that part of the Mississippi River which is in Iowa and Illinois has led a number of interested persons to request the United States Fish Commission to make an investigation of the subject, as this is the section in which the business is most extensive and has been longest established. In compliance with this request the writer was assigned to the investigation and visited the centers of the business in July, 1898. The present report is based on the observations then made.

The principal inquiries were conducted at Muscatine, Iowa, the leading center of the button industry, although some other important places, as Clinton and Davenport, were also visited. Many fishermen and manufacturers were consulted with regard to the important features of the business. The manufacturers, without exception, furnished detailed statistics concerning their work. Those whom it was not practicable to personally visit were corresponded with, and, with few exceptions, they have supplied the desired data.

The statistics herein presented relate to the calendar year 1897 and to the first six months of 1898, when there was a remarkable development of the button-making business. The figures are the first which have been collected covering this industry, and will prove useful in determining the changes which may take place in subsequent years.

The investigation naturally embraced the following general topics, which are hereafter specially considered: (1) The mussels utilized in button-making, (2) the mussel fishery, and (3) the button industry. To these is added a chapter embodying a statement of the measures that appear to be demanded in order that the stability of the industry may be maintained.

THE MUSSELS UTILIZED IN BUTTON-MAKING.

While there are probably 400 species of mussels found in the Mississippi River and its tributaries, comparatively few are now utilized in or are adapted to button-making. The requirements of a shell, from the button-maker's standpoint, are sufficient thickness, a uniform color of the surface and various strata of the shell, and a degree of toughness that will withstand the necessary treatment without cracking or splitting.

Thin-shelled mussels are absolutely useless for button-making. Even if originally as thick as a button, the necessary grinding and polishing reduce them to mere wafers. The preferred color is white, but cream-colored shells are also employed. Shells with pink, purple, yellow, or salmon-colored nacre are not suitable, as the color fades with age and is apt to be not uniform. Certain shells that satisfactorily combine thickness and color are nevertheless useless, because they are soft or brittle and break easily during manufacture. Dead shells that have been exposed for a long time to the action of air or water also become useless for button-making.

Mr. Charles T. Simpson, of the department of mollusks of the United States National Museum, has courteously supplied the newly revised scientific names for the mussels used in the button industry, and has given valuable information concerning this family of mollusks, with which he is so familiar. For a very interesting and timely article on the fresh-water mussels, considered from the standpoint of the biologist, reference is made to Mr. Simpson's paper entitled "The pearly fresh-water mussels of the United States, their habits, enemies, and diseases, with suggestions for their protection," published in the Bulletin of the U. S. Fish Commission for 1898.

Coincident with the establishment of the mussel fishery and button industry in Iowa and Illinois, there has arisen a new popular nomenclature for the mussels or "clams" utilized. The names applied by the fishermen and manufacturers have some reference to the color or shape of the shells. Originally quite local, they are now generally applied throughout the whole stretch of river in which fishing is done.

The principal species of mussel in the Mississippi River used in button-making is *Quadrula ebena*, generally known as the "niggerhead." This species has the general shape of a common round clam (*Venus mercenaria*), and is characterized by a very thick and heavy shell, with a black or dark-brown outside skin and a glistening white interior, the latter color being uniform through the thickness of the shell. It is of relatively small size, the maximum being only 4½ or 5 inches for the greatest outside diameter and the average about 3 inches. Many less than 2 inches wide are also unnecessarily destroyed. It is often found over immense areas, preferring muddy sand and muddy gravel bottom, but also frequenting sandy bottom. In some places a form of this mussel known as the "mud niggerhead" is sparingly used. It is found on muddy bottom, and has a thicker shell and a more intensely black epidermis than the common form.

Several abundant species of mussels resembling the niggerhead in shape, but differing from it in having tubercles or excrescences on the outside of the valves, are locally known as "warty-backs" or "warty-back niggerheads" (*Quadrula pustulosa; Q. metanevra*). They have very little value for buttons, the warts causing the shell to crack during cutting.

Another species of this class that is abundant, but only sparingly used, is the "bullhead" (*Pleurobema æsopus*). It is found with the "niggerhead," has a thick shell with a blackish-brown skin and a white interior, and externally presents several radiating ridges. It is of little value, as the shell is brittle and cracks in cutting, and the buttons also split in facing and drilling.

There are several kinds of mussels known along the Mississippi as "sand shells." The most abundant and important of these is the "yellow sand shell" or "yellow-back" (*Lampsilis anodontoides*), which has a bright yellowish-brown epidermis and a faintly cream-colored interior. Another species with a black exterior is known as the "black sand shell" (*Lampsilis rectus*). The sand shells are found chiefly on sandy

bottom, and are reported to be quite active, moving toward the shores in the morning and back toward the channel in the evening, making conspicuous tracks on the bottom. These mussels, which are long and narrow, reach a length of 6 inches, and are highly valued in button-making.

A smaller species is the "slough sand shell" (*Lampsilis fallaciosus*), which seems to be most common in or near the mouths of narrow arms of the river, especially coves that extend into islands. It is less generally distributed in the river than the "yellow sand shell," occurs in much smaller beds, and is now quite scarce in most places where extensive fishing has been carried on. It is considered very good for buttons, having a beautiful pearly color and uniform thickness. It has been practically caught out in the vicinity of Muscatine, near which place a bed yielded 10 tons a few years ago and ceased to exist.

Ranking next to the sand shells in abundance is the species known as "mucket," "mouket," or "mougat" (*Lampsilis ligamentinus*). It attains a length of 6 inches, but the average size of those utilized is only about 4 inches. It has a dark-brown exterior and a creamy-white nacre. Only second-class buttons are made from it, as the front part of the shell is thin and the back part brittle. New factory hands are usually set to work on this species.

One of the best mussels for buttons is known as the "deerhorn" or "buckhorn" (*Tritigonia verrucosa*). It is not abundant, and the supply is irregular and uncertain. It attains a large size; examples over 9 inches long have been taken from the Iowa River, and in the Mississippi it reaches a length of 6 inches or over, the average being about 5 inches.

A rare but very desirable mussel is the species locally known as the "butterfly" (*Plagiola securis*), in allusion to the shape of the valves. The flat shell is of small size, but thick and of a fine color. The epidermis is reddish-brown, marked by dark radiating lines. In 100 tons of miscellaneous shells from the Mississippi River, in the Muscatine section, there are likely to be only a few hundred pounds of "butterflies." In the Illinois, Ohio, and some other tributaries of the Mississippi, this mussel is abundant.

A mussel not very highly regarded by the button-maker, but sometimes used, is the so-called "blue-point" (*Quadrula undulata*). It has a large, thick shell, with a wavy exterior; the nacre at one end is usually of a bluish or purplish color, in contrast with the white surface of the remaining part. The chief objection to its employment in button-making is the lack of uniformity in color.

Another species not highly regarded is the "hatchet-back," or "hackle-back," (*Symphynota complanata*). This is a large, black mussel with a projecting wing. The valves are thin and of an undesirable color, and only a very small section of each is suitable for buttons.

Several species of "pocketbook" clams (*Lampsilis capax* and *L. ventricosus*) are more or less abundant and yield a good button of medium thickness. They are characterized by having rounded valves of great depth.

Nearly all the tributaries of the Mississippi in this section contain mussels in some abundance, but no mussel fishing is done in them. The Iowa and Cedar rivers, for instance, have a good supply of large "muckets" and large "blue-points," which are the principal species; also pink and white "hatchet-backs," a few fine "sand shells," a very few "niggerheads" and "pocketbooks," and some extra large "deer-

horns" of good quality, the last-named constituting about 10 per cent of the mussels adapted for button-making. There is no fishing now carried on in these streams, although there was a little six years ago. It does not pay to ship the shells, and there is no local demand. In the Skunk and Des Moines rivers there are some shells that might be utilized, but they are not sufficiently abundant to maintain a large factory. Among others there are small, brittle "muckets" of little value, a few desirable "pocketbooks" and "sand shells," and some very good medium-sized "deer-horns." In Rock River, Illinois, there is reported an enormous growth of "muckets" which are not utilized.

A number of animals prey on the mussels, among them the muskrat, the mink, and the raccoon, the first named being especially destructive. Catfish are also said to eat mussels. Hogs are known to be very injurious in some parts of the country.

Physical causes are undoubtedly responsible for extensive destruction of mussels. During freshets mud and sand are deposited on the beds and bury the mussels. Shifting sand-bars are also known to cover up beds. The fishermen sometimes find extensive beds of dead shells which appear to have recently been uncovered by the current. During freshets, when the streams find new channels, many mussels are carried from their beds and left dry when the water subsides. Droughts also are liable to expose mussel beds and cause much destruction.

Pollution of the water by refuse from cities and manufacturing establishments is perhaps the most serious menace to the mussel beds, next to the operations of the fishermen. Certain kinds of refuse are very destructive and are capable of killing practically every mussel with which they come in contact.

Fishermen and button-makers report a considerable percentage of "niggerheads" with the beaks partly gone, the remaining portion being softened and easily split into laminæ. Accompanying this condition there is often a softening of the other parts of the shell in spots. Only the larger (older) shells are thus affected, and it appears to represent a natural decay due to age. Buttons made from such a shell are soft, and are apt to split up into layers in the course of manufacture.

For much interesting information concerning the habits, spawning, mode of dispersal in the streams, rate of growth, etc., of the mussels, the paper of Mr. Simpson should be consulted.

THE MUSSEL FISHERY.

THE FISHERMEN.

The mussel fishermen in the region under consideration are mostly people who have been engaged in other branches of fishing, or who, as boatmen, etc., are familiar with the river. Many of them depend on mussel fishing for their livelihood and follow it throughout the year, but others seek mussels only when their regular work is suspended. Thus, in winter especially, the ranks of the regular mussel fishermen are considerably augmented by sawmill hands, farm hands, and others. Owing to the increase in the mussel fishery during the past two or three years, it is said that many farmers have had difficulty in obtaining men to work on their farms.

It is reported that in 1897 there were, between Burlington and Clinton, in Iowa, over 300 persons who engaged in taking mussels to sell to the button manufacturers at the various towns along that part of the Mississippi. In 1898 the number

STEAM DREDGE SPECIALLY CONSTRUCTED FOR THE MUSSEL FISHERY, MUSCATINE IOWA.

SCOW, WITH DREDGE AND WINDLASS, EMPLOYED IN MUSSEL FISHERY OF MISSISSIPPI RIVER.

of fishermen between Fort Madison and Sabula was estimated at 1,000. As many of the fishermen have no permanent headquarters, but move from place to place, it is difficult to obtain an accurate statement of their number.

The leading fishing and button-manufacturing center is Muscatine, at which place in 1898 there were about 100 mussel fishermen. On an extensive and productive bed, as many as 150 to 300 fishermen may be engaged at one time.

In view of the small amount and inexpensive character of the apparatus required to prosecute the fishery, the comparative ease with which the mussels are taken, and the little experience required, mussel fishing is regarded with favor by many men, as they are readily able to get their catch to market and dispose of it, receiving cash in payment. When they find a good mussel-bed they sometimes make $30 or more per week. The average earnings, however, are considerably less, at this time probably being less than $10 per week. Some days $2 or $3 will be made, but inclement weather prevents fishing and reduces the average.

The income of the mussel fishermen is now generally less than formerly, owing to the increase in the number of fishermen, the lower prices received for their catch, and the reduced abundance of the mussels.

APPARATUS AND METHODS.

Owing to the comparatively shoal water in which mussels are found, they may be gathered with less difficulty than is ordinarily encountered in taking shellfish. Furthermore, the shoalness of the Mississippi makes every part of it accessible to the fishermen and renders the exhaustion of the beds more certain, speedy, and complete.

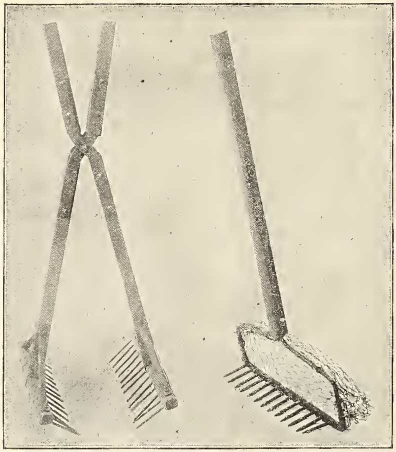
Mussels are obtained with various kinds of apparatus. Those which have been or are now in use are the hand-rake, the tongs, the rake hauled by means of a windlass, the dredge operated by steam, and the bar with hooks.

The rakes are of several patterns, but all are essentially alike. The commonest form, known as the shoulder rake, has a wooden handle 14, 16, 18, or 20 feet long, attached to one side of an elliptical metal frame; on the under side of the frame are 12 to 14 iron teeth 5 inches long; the head of the rake is converted into a kind of basket by a piece of coarse wire netting attached to the frame; the mouth of the basket is 8 inches deep, 6 inches wide, and 16 inches long. The rake is used from an anchored boat. The handle is placed over the fisherman's shoulder, and the rake is placed upstream to the full length of the pole. The fisherman then slowly works the rake toward his boat, being aided in this by the action of the current on a broad wooden piece nailed crosswise near the base of the handle. The rake is then lifted perpendicularly from the water and the mussels are emptied into the boat. This rake is also used through the ice.

The tongs, which along parts of the Mississippi are called "scissor rakes," are similar to the ordinary oyster and clam tongs. They are used in water as deep as 15 feet, but usually in only 10 feet or less. The value of the tongs is $3 or $3.50 each.

The dredge or rake used with a windlass, locally known as the "drag rake," is larger and heavier than the shoulder rake and of different shape. It has a rectangular iron framework covered with narrow strips of hoop iron placed about an inch apart. The apparatus has the appearance of a flat cage, with long teeth projecting obliquely downward from the anterior lower margin. The rake, with the windlass and rope, is worth about $25.

A large steam scow for taking mussels, owned at Muscatine, is unique. It is provided with a huge rake or dredge operated by steam. The rake is made of iron and weighs 500 pounds. It is 48 inches long, 18 inches wide, and 30 inches deep, and is provided with twenty-five 8-inch teeth. The rake is operated in a recess or slot in the bottom of one side of the scow. This recess is 5 feet wide and 40 feet long, and is surmounted by a framework with a double track, on which the heavy timbers supporting the rake slide while the rake is being dragged along the bottom. A perpendicular beam is attached to the rake, by means of which it is raised and lowered and dragged from the forward end of the recess. The length of this beam is such that the rake may be used in water as deep as 22 feet. This vessel carries a crew of four men and cost several thousand dollars. It has not been sufficiently used to demonstrate whether it can be profitably employed with the mussels so much less abundant and more scattered than formerly.



Tongs and rake used in mussel fishery of Mississippi River.
(Only a part of handles is shown.)

In the spring of 1897 a very ingenious contrivance for taking mussels came into use and is now the leading means of capture. It consists of a circular rod, 6 feet long, of $\frac{5}{8}$-inch iron, to which are attached, at intervals of about 6 inches, series of four-pronged hooks made of stout (No. 9) wire. These hooks are made of two pieces of wire so fastened together that the prongs will be at right angles to each other. The hooks are 4 inches long and are fastened to the iron bar in strings containing two or three hooks, which are attached to each other and to the bar by twine, pliable wire, or chains, so they will be freely movable. A strong piece of rope is tied at or near

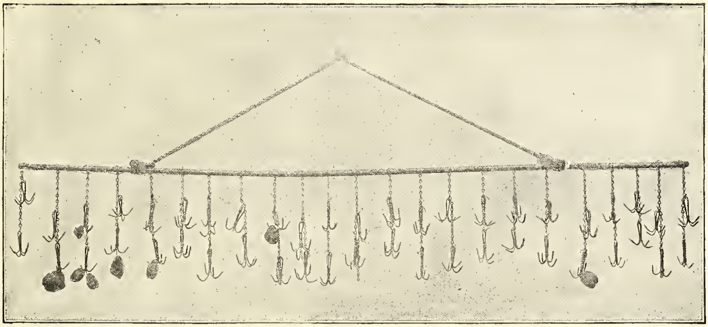
each end of the bar, forming a bridle, to which is fastened the bail, or the rope by which the dredge is pulled. This rope is about 25 feet long. The quantity of hooks varies with the length of the bar and the number in each string. A 6-foot bar, with 3 hooks on each string, the strings being 6 inches apart, would have 39 hooks. A 7½-foot bar, such as the one herewith illustrated, with only 2 hooks on a string and the strings 4 or 5 inches apart, would contain 46 hooks.

In allusion to the shape of the hooks, this apparatus is locally known as the "crowfoot" dredge or rake.

The usual outfit for a fisherman is two dredges, valued at $1.50 to $2 a pair.

A modification of this appliance consists in putting wooden wheels, 6 inches in diameter, on the end of the iron bar, so that the bar will clear the bottom as the dredge is hauled, and will not disturb the beds.

This apparatus depends for its action on the habits of the mussels. They rest on the bottom, or partly buried in the mud or sand, with the free margin of their shells



"Crowfoot" dredge or grapple, showing mussels attached to the hooks.

turned upstream and with their shells separated to admit the water, laden with oxygen and food. When touched, they quickly close their shells, and if a foreign body is interposed between the valves it is tightly grasped and retained.

The method of using this applianee is as follows: The fisherman throws it overboard from his boat and allows the boat to slowly drift downstream. As the numerous prongs come in contact with the open shells, the latter quickly elose on the hooks and retain a tight hold. After drifting for a short distance, say 50 feet, the dredge is drawn in and the mussels removed from the prongs, considerable force often being required to detach them. In order to faeilitate the handling of the dredge, the fishermen place two upright forks on each side of the boat, on which the dredge-bar rests, the hooks swinging freely. The shorter bars are supported across the ends of the boat, while the larger ones rest on side uprights. While the mussels are being taken from one dredge, the other is being dragged and is ready to be hauled in by the time the first is stripped.

Any one who has not witnessed the use of this apparatus can scarcely realize how

remarkably effective it is. Often when the mussels are abundant almost every prong will have a mussel on it, and two or three are sometimes caught on one prong. The writer saw 60 marketable mussels taken on 39 hooks, and has often observed large clusters of shells on a single string of hooks. When the beds of mussels are compact one man can take 800 to 1,000 pounds of "niggerheads" in a day, and a case is reported where 2,200 pounds were obtained by one man in 10 hours. The average daily catch at present, however, is probably not over 500 pounds.

On account of the cheapness and efficiency of this apparatus, together with the ease of operating it, it has become very popular with the fishermen and has practically superseded all other appliances. It is said to reduce the labor of fishing about half, as compared with the shoulder rake and dredge. Another advantage is that it takes only live shells, while the other appliances are often loaded with dead shells, trash, etc. By its use a larger area can be covered and fishing done on grounds that could not be profitably worked by other means, owing to the shells being much scattered.

After sufficient ice forms on the river there is considerable mussel fishing through the ice with "shoulder rakes" and "scissor rakes." For the use of these appliances under such circumstances a hole 2 to 6 feet square is cut through the ice.

Ice fishing presents an interesting scene when large numbers of fishermen are working at one time on the same ground and engaged in the various steps of the business—some sawing holes through the thick ice, some drawing their rakes, some sorting their catch, some taking their catch to shore, and some returning to the grounds with their empty vessels.

Among the illustrations herewith presented are two showing men engaged in ice fishing near Leclaire, Iowa, in the winter of 1898–99. The bed on which the fishing is being done is nearly a mile long and about 100 yards wide. It has been worked for several years, in both winter and summer, and has yielded large quantities of "nigger-head" mussels. On one occasion, in the winter of 1898–99, 142 men were digging mussels at one time on that part of the river shown in the views, and up to the latter part of February they had obtained over 500 tons of shells from this section. When the photographs were taken, shortly after a period of excessively cold weather, when fishing was suspended, only a few of the fishermen had returned to work. The ice is 12 to 28 inches thick, and the water over the bed is 8 to 14 feet deep. One man is seen sawing a hole through the thickest ice. Some men work alone, others in pairs. When two operate together, one uses the rake while the other sorts the mussels, frequent change of duty being made, as the hauling of the rake is quite arduous. One of the long-handled rakes, with fine, long tines, is shown. One man can dig or rake from 600 to 800 pounds of shells daily on such a bed. They are sorted in pails, emptied into box sleds, and hauled over the ice to the place where they are weighed and paid for.

The fishermen who use the shoulder rake or "crowfoot" have small flat-bottomed skiffs, worth from $5 to $10 each. Those employing dredges have a barge or flat boat with deck room sufficient for the manipulation of the windlass and dredge, and also a temporary cabin. Such a boat is valued at $20 or more.

Some fishermen have large house-boats, which are moored at places convenient to the fishing-grounds and serve as temporary homes. The value of such boats is about $200. Usually a fisherman and his family will occupy one boat, and live very comfortably during the fishing season.

MUSSEL FISHING THROUGH THE ICE, WINTER OF 1898-99, MISSISSIPPI RIVER NEAR LECLAIRE, IOWA

MUSSEL FISHING THROUGH THE ICE NEAR PRINCETON, IOWA, ON THE MISSISSIPPI RIVER, WINTER OF 1898-99.

The fishermen have crude, oblong tanks, located at some convenient place on shore, made of sheet iron, capable of holding water. A fire is built under the tanks, and the mussels are boiled 10 or 15 minutes in order to kill them and permit the extraction of the fleshy part. Under the influence of the heat the shells open, and the meats either fall out or are readily picked out by hand. After being thus prepared, the shells are loaded in sacks and sent by steamer to the button factory, or they may be taken to market in the fisherman's boat. Sometimes large scows are loaded with shells at a camp and towed to the factory town by a tug. Shells are also sold on the shore to buyers representing the local button-makers or factories in other States.

A view is presented showing a part of a "boiling-out" shed, at Leclaire, Iowa, where many of the fishermen disposed of their catch in the winter of 1898–99. The shed, which is 40 feet square, has three furnaces, on which are huge boiling pans, each holding 20 bushels of mussels. The mussels are boiled for about 15 minutes and then thrown out on tables, when the meat easily comes from the shells as they are broken or pulled apart and thrown into a heap. When photographed, this shed contained 200 tons of cleaned shells, while outside were 350 tons in heaps.

The fishermen make no use of the "meats" removed from the shells in cooking. In some places the meats are eagerly sought by farmers who go to the fishing shores, collect this waste product without cost, and feed it to hogs and poultry. It seems probable that the fishermen might add materially to the proceeds of their fishing by finding a market for this waste. The quantity is, in the aggregate, large, amounting in the first half of 1898 to fully 500 tons. From a ton of niggerhead mussels as taken from the water over 300 pounds of meats may be obtained. The food value of the mussels is practically *nil*, and only limited quantities are used for bait in line fishing. It is possible, however, that a market for the meats, in a salted condition, may be found in the Atlantic coast States, where salt clams are extensively employed in the line fisheries for cod, haddock, hake, and other ocean fishes. Recently, considerable quantities of fresh-water mussels, taken from ponds in southern Massachusetts, have been salted and sold to cod fishermen at a good price ($4 or $5 per barrel of 200 pounds). Even at $3 per barrel, the Mississippi River fishermen could well afford to send their waste mussel-meats by freight to the coast. It is not known just what effect cooking has on the quality of the meats, but it is thought that this process does not seriously impair their value as bait.

THE FISHING SEASON.

In the early days of the industry, fishing was carried on from about August to December, but of late it has been conducted throughout the year, even after the river is frozen. The principal fishing, however, is still done in late summer and fall, when the river is lowest. On one bed, near Muscatine, 50 persons were at times engaged in ice fishing in the winter of 1897–98, and on other large beds as many as 200 persons have been employed at one time. Ice fishing is of comparatively recent origin, having been first carried on only during the winter of 1896–97. The quality of the shells is better in cold weather for the purpose of the button-maker. The mussels are then less brittle, while warm weather, with prolonged exposure in boats, makes them brittle.

The question of a close season for the mussel fishery, in order to afford the mussels a respite from incessant hunting, especially during their spawning time, is now being agitated and is hereinafter discussed.

THE FISHING-GROUNDS.

The Iowa and Illinois button factories located on the Mississippi River obtain their supply of shells from grounds which extend from Fort Madison, Iowa, to Sabula, Iowa. This section of the river is 167 miles in length, following its sinuosities, although the distance in an air line between the points named is only 118 miles. The average breadth of the river is two-fifths of a mile, the maximum unobstructed width being about 1 mile, just north of Campbell Island, between Leclaire and Davenport.

This part of the Mississippi is quite shallow at the mean stage of the water. The usual depth in the channel is 12 to 14 feet, the deepest water being only 33 feet. On either side of the channel the bottom generally slopes gradually to the shores. In the latter part of summer and the early fall the depth is always reduced by the diminution in the volume of water coming downstream, while in winter, spring, and early summer the river is swollen by rains and melting snows; there being every season a freshet of greater or less severity.

The character of the bottom varies greatly, but it is usually sandy, sand-bars and low sandy islands being common features. There are, however, more or less extensive areas of muddy bottom, and in some places rocky or gravelly bottom prevails.

Owing to the shoalness of the river and the character of its bed, the annual freshets produce marked changes in the bottom topography. These changes have an important relation to the mussel beds, which are sometimes entirely swept away and sometimes completely destroyed by being covered with sand or mud; such beds of dead shells are not infrequently found by the fishermen when subsequent freshets have swept off the overlying sand or mud.

Throughout the river section mentioned, mussels are found in scattered or in condensed bodies. The natural tendency of some of the species is to form more or less dense beds, while others seem to be uniformly distributed. Considered as a whole, this part of the Mississippi River is undoubtedly one of the most favored sections of the United States as regards abundance and variety of mussels adapted for buttons. By far the greater portion is taken from special areas on which they are more abundant and more closely grouped than in other places. Such beds, which are sometimes of great extent, have their principal axis lengthwise the river, and are often quite narrow.

On some grounds practically all of the mussels are of one species, while on others several species may be mixed in varying quantities. The largest and most compact beds are formed of "niggerheads" and "muckets." On new grounds the "niggerheads" are sometimes so thickly disposed that practically the entire bottom over a large area is covered, and the shells are often found several layers deep. In holes or depressions in the sandy or muddy bottom "niggerheads" are often discovered in thick piles, and many bushels may be taken from one of these holes.

Owing to the crowding of the mussels, some of the fishermen think that fishing is beneficial to the beds, in that it spreads the mussels over a larger area and permits a more rapid growth and increase of those that remain. There is a popular belief among some of the fishermen that depleted beds may be reestablished in three years—that is, the mussels are thought to reach a marketable size in three years after the young are hatched. Most of the fishermen and manufacturers, however, have no definite knowledge as to the rate of growth, although all think it more rapid than is actually the case.

Among the more noteworthy mussel beds that have been worked in the past few years are the following:

In 1896 a bed of "niggerheads" and "muckets" in front of Muscatine, about 2 miles long and ¼ mile wide, yielded 500 tons of shells.

A very large bed was discovered near New Boston, Ill., a few years ago. It was about 1½ miles long and 60 rods wide, with the shells very thickly disposed. It is reported that fully 10,000 tons of shells, chiefly "niggerheads" and "muckets," with a few "sand shells," were taken during the past three years. The number of mussels represented by this enormous quantity was probably not less than 100,000,000.

There is a very large and productive bed 3 or 4 miles below Clinton, on the Illinois side of the river; it is a mile long and several hundred feet wide. The shells in places are reported to be several feet deep, but the greater part of those lying deepest are dead.

One of the most noted beds in the upper river is near Camanche.

In 1898 the principal mussel fishing was done between Davenport and Clinton. While other parts of the river were also resorted to by the fishermen, the bulk of the catch was from beds in the upper river that had not been so actively worked as those in the vicinity of Muscatine and other places as far down as Burlington.

In July, 1898, when the writer visited the river, a number of camps of "clam" fishermen were met with between Davenport and Clinton. One of these, located directly on the bank of the river, was quite extensive and presented an interesting scene as the numerous boats brought in the shells from the adjacent river, and as the catch was being cooked and piled up at the headquarters of each crew. The principal apparatus in use along this section was the grapple, although a few shoulder rakes and drag rakes were also seen.

The shells for the Davenport factories come chiefly from the vicinity of Princeton, where there is a great abundance of mussels. In May, 1898, the fishermen were restricted in bringing in their catch, as the factories could not handle all of it. Although there are a good many "muckets" in the river in the vicinity of Davenport, there was in 1898 no demand for them.

Reference has already been made to the productive bed near Leclaire, Iowa.

DEPLETION OF THE GROUNDS AND ITS CAUSES.

Although the mussel fishery along this section of the Mississippi River is under ten years old and in most places began within the past two or three years, it has already had a pronounced influence on the productivity of the mussel beds and bids fair to lead to serious consequences to the capital invested in the button industry of the States of Iowa and Illinois. Throughout this stretch of river, wherever fishing has been at all regular or active, there has been a more or less marked reduction in the abundance of mussels of all kinds utilized in making buttons, and in some localities the depletion of the grounds has been almost complete.

The manufacturers generally recognize the present tendency toward the practical exhaustion of the available grounds, and feel the need of some action that will place the industry on a permanent basis. The fishermen also, however loath they may be to acknowledge it, have practical evidence that the mussel grounds are capable of depletion and are being greatly reduced in productiveness. The many persons financially interested in the mussel fishery and the button industry are very desirous that appropriate measures be taken to insure the existence of a substantial business of this

kind. Suspension of the industry along this part of the river—which is not a remote contingency—would prove a calamity to many of the communities.

The present condition of the principal grounds, before referred to, illustrates the serious effects of indiscriminate fishing and emphasizes the solicitude felt by the button-makers and others for the maintenance of the supply. Thus, the large bed in front of Muscatine was unable to stand the drain of one year's fishing, and now yields few mussels. The New Boston bed, reported to be the best in this section of the Mississippi, was so assiduously worked that it was completely exhausted, few fishermen resorting to it in 1898. The abundance of mussels was incredible, and yet a few seasons' operations depleted this ground. It is reported that when fishing first began on this bed some men took as much as 1,500 to 2,000 pounds of shells in a day's fishing, but now a fisherman would have difficulty in getting that quantity in a week.

Between Burlington and Davenport the condition of the beds is such that many fishermen no longer resort to them, but go to grounds that have been worked for a shorter time. Up to July, 1898, there had been no noteworthy decrease in the mussels in the river near Davenport, but the fishery there is still quite young, and the manufacturers are anticipating a decrease.

Owing to the very slow growth* of the mussels and the comparative facility with which the fishermen exhaust new grounds, there is no reason to believe that depleted beds will recuperate while the grounds on which fishing is now being done continue to be productive, so the indications are that the conditions will steadily grow more unsatisfactory.

The history of the fishery up to this time shows the disregard for the future which has come to be regarded as characteristic of fishermen. The decrease in the mussel supply has been brought about by several practices. The principal factor has been the activity of fishing operations. Not only have large quantities of mussels been taken from the bed at one time, but the fishing has been so incessant that no opportunity has been afforded the beds to recuperate. The shoalness of the water has made it possible to thoroughly scour almost every foot of ground. The high water that prevails during a part of the year was formerly a protection to mussels at an important time, but it is so no longer, as the present apparatus may be used at all times when a boat can be managed.

The failure of the fishermen to suspend their operations immediately prior to and during the spawning season of the principal species of mussels has undoubtedly had a serious effect on the supply. This question has been freely agitated in the local press, and the sentiment among most of those interested, including fishermen, favors protection for the mussels at this critical time. Under the impression that the spawning occurs in spring, they advocate a close time at that season.

A good many fishermen and manufacturers expressed the view that ice fishing is unduly destructive, owing to the fact that enormous quantities of mussels—some as small as 1 inch in diameter—are brought up and left on the ice to freeze and die. These, in open water, would drop back or be thrown back as the catch is removed from the rakes or tongs, or when the boats are cleaned. Aside from this damage, many think the shells should be unmolested during the winter, when they are more

* For example, the time required for a "niggerhead" mussel, under normal conditions, to reach a size of 3 inches is not less than 10 years and is perhaps generally as much as 12 years, while a shell 4½ inches in diameter is from 15 to 18 years old.

COOKING MUSSELS TO REMOVE THE MEATS. SHORE OF THE MISSISSIPPI IN MIDWINTER.

HOUSE-BOAT USED IN MUSSEL FISHERY OF MISSISSIPPI. Occupied by fisherman and his family.

or less dormant. Many persons expressed themselves as favoring the prohibition of ice fishing.

The suspension of the ice fishing and spring fishing would, of course, keep many fishermen out of employment at a time when they need ready money. There is little reason to believe, however, that it would reduce their annual earnings, even at the outset, while ultimately it would undoubtedly prove financially beneficial. The manufacturers report that no injury would result to the button business from their failure to receive shells during a closed season, as they could—as most of them now do—lay in sufficient supply in summer and fall to keep the factories running.

Not the least injurious feature of the fishery is the gathering of small mussels for market and the incidental destruction of small shells that are not utilized, but left on the banks or the ice to die. The testimony of the button manufacturers and the evidence afforded by their shell-heaps indicate that there are comparatively large quantities of immature mussels taken. This practice depends to some extent on the depletion of the grounds of the larger mussels, necessitating the gathering of the smaller ones to make a fair catch, but also on the indifference of the fishermen to the great injury thus done the mussel supply. The manufacturers are, of course, equally indiscreet in continuing to purchase lots of small shells, and a few of them refuse to do so, but it is generally not feasible to exclude the small shells mixed with the larger ones. The desire that there should be some restriction on the size of the shells taken is quite general among the manufacturers. However, as long as the fishermen bring them in, the manufacturers will buy them. Some of the button-makers, indeed, prefer comparatively small shells—say niggerheads 2¼ or 2½ inches in diameter—for the reason that their quality is as good as or better than many of the large shells, and the waste is relatively less.

If no mussels smaller than 2½, 2¼, or even 2 inches in diameter were gathered, the matter would not be so serious, although it must be acknowledged that shells less than 2½ inches in diameter are very small, but many mussels only an inch in diameter have been sacrificed, and some of the manufacturers report that considerable numbers of shells no larger than a nickel or a dime are brought in. From a niggerhead shell an inch or less in diameter, only one medium-sized blank may be sawed. Thus, for two buttons, a mussel is sacrificed which, in a few years, would have yielded 8 to 12 times as many.

PRICES RECEIVED FOR SHELLS.

The prices which the fishermen receive for shells vary considerably, depending on the supply and demand. The size and kind of the shells also affect the price. The standard shell is the niggerhead. In 1897 the market value of this species in Muscatine ranged from 40 to 62 cents per 100 pounds. Shells were cheaper in 1898 than at any previous time, but in February, 1898, there was a scarcity of shells at the factories, prices went up to $18 and $20 per ton, and many fishermen were thus induced to enter the business for the first time, and the supply was soon in excess of the demand. By July, 1898, the prices had fallen as low as 30 cents per 100 pounds for small "niggerhead" shells and 35 cents for large ones.

The ruling prices for other shells in 1897 were as follows, per 100 pounds: Sand shells, $1.70; muckets, 30 cents; deerhorns, $2; pocketbooks, 50 cents. The other species—bluepoints, butterflies, bullheads, hatchet-backs, etc.—are seldom sold sepa-

rately, but are mixed with some of the shells named. Slough sand shells bring $1.50 to $2 per 100 pounds, but few have been obtained in recent years.

When fishermen dispose of their catch without removing the meats, the prices usually range a fourth lower than for cleaned shells; thus, when "niggerheads," as usually sold, are bringing 40 cents per 100 pounds, those disposed of as they come from the water are worth only 30 cents.

It has been determined by actual count that in 100 pounds of the average size "sand shells" there are about 900 to 912 valves or half-shells. In 100 pounds of "niggerheads" of the average size now taken there are 970 to 1,000 valves. These numbers seem high when the thick and heavy shell of this species is considered, but they have been amply verified and indicate the inordinate use of small mussels to which reference has been made. In 100 pounds of "muckets" there are 800 valves. Thus, in a ton of "niggerheads" there are 9,700 to 10,000 complete mussels represented, in a ton of "muckets" 8,000 mussels, and in a ton of "sand shells" from 9,000 to 9,120 mussels.

SHIPMENT OF MUSSELS TO OTHER STATES.

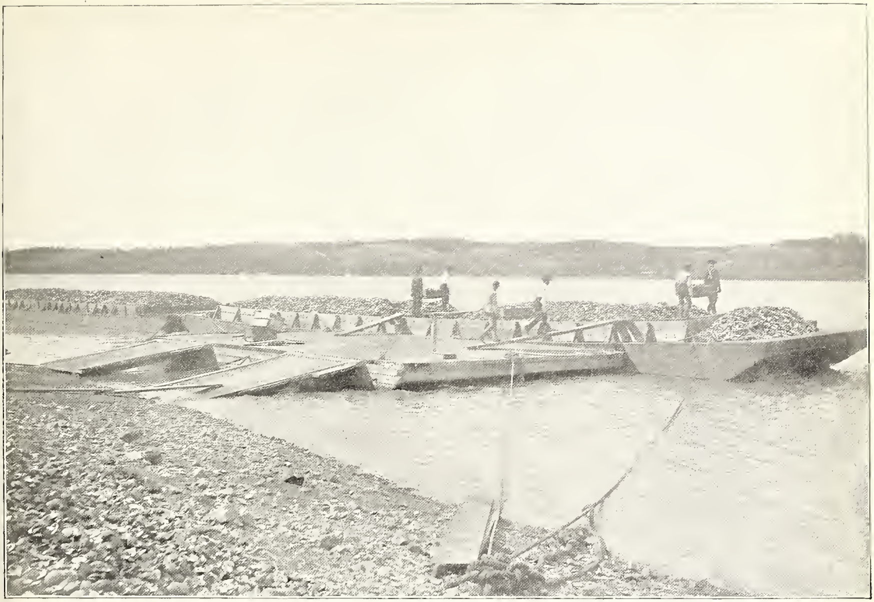
In 1897 a rather important business sprung up at Muscatine consisting in the purchase of large quantities of shells from the local fishermen and their shipment by train to button-manufacturers both east and west of the Mississippi. The business is restricted to "niggerheads" and "yellow-backs." In 1897 the fishermen received on an average 40 cents per 100 pounds for the "niggerheads" and $1.50 per 100 pounds for the "yellow-backs." In 1898, up to July 1, the prices were 35 cents and $1, respectively. The shells are mostly shipped in carload lots, although a few are sent in smaller quantities packed in sacks. The amount of the shipments in the first six months of 1898, namely, about 14 carloads, was almost as large as during the entire season of 1897, when the equivalent of 14⅓ carloads was shipped, but the cost value of the shells was much less in 1898.

Shipments of shells are also made from other places on the Mississippi, and the business seems to be growing. In the winter of 1898–99 one buyer at Leclaire, Iowa, had a contract for 1,000 tons of shells to be shipped to New York.

Other States to which mussel shells have been sent from this part of the Mississippi are Michigan, Pennsylvania, Nebraska, New Jersey, in addition to a number of places in Iowa and Illinois not on the river.

The extent of the business at Muscatine in 1897 and in 1898 to July 1 is shown in the following table:

Year.	Kinds of shells.	Shipped east.		Shipped west.		Total.	
		Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.
1897	Niggerheads	160,000	$640	100,000	$400	260,000	$1,040
	Sand shells	170,000	2,550			170,000	2,550
	Total	330,000	3,190	100,000	400	430,000	3,590
1898 (to July 1)	Niggerheads	300,000	1,050	60,000	210	360,000	1,260
	Sand shells	60,000	600			60,000	600
	Total	360,000	1,650	60,000	210	420,000	1,860



LOADING MUSSELS ON SCOWS AT LECLAIRE, IOWA, FOR TRANSPORTATION TO MUSCATINE.

SCOWS AT LECLAIRE, IOWA, LOADED WITH MUSSELS ABOUT TO BE TOWED DOWN THE MISSISSIPPI BY STEAMER.

RECENT STATISTICS OF THE MUSSEL OUTPUT.

The quantities of mussel shells which were taken by the fishermen and sold to the button manufacturers in 1897 and the first six months of 1898 are shown in the following table. The total output is seen to have been 3,817 tons in 1897 and 3,950.74 tons in the first half of 1898. For these quantities the fishermen received $43,998 and $38,868, respectively.

The predominating importance of the niggerhead mussels (*Quadrula ebena*) is apparent, as these constituted 89 per cent of the yield in the first-named year and 94 per cent in the latter. The sand shells are second in importance, and are taken in larger quantities than all the remaining species combined.

Quantities and values of mussels sold by the mussel fishermen on the Mississippi River in 1897 and 1898.

Species.	Tons.	Value.
1897.		
Niggerheads	3,414.00	$34,149
Sand shells	299.00	8,960
Muckets	81.75	287
All others	22.25	602
Total	3,817.00	43,998
1898 (first 6 months).		
Niggerheads	3,709.00	$36,891
Sand shells	102.60	1,662
Muckets	26.25	154
All others	12.89	161
Total	3,950.74	38,868

In 1897 the average prices per ton received by the fishermen were $10 for niggerheads, $29.97 for sand shells, $3.51 for muckets, and $27.06 for all others, the general average price being $11.53. In 1898 the prices were $9.95 for niggerheads, $16.20 for sand shells, $5.87 for muckets, and $12.50 for the others, with a general average of $9.84.

THE BUTTON INDUSTRY.

ORIGIN AND PRESENT IMPORTANCE OF THE BUTTON INDUSTRY.

The manufacture of buttons from the native fresh-water shells began in the United States in 1891, the inauguration of the business being made possible by the high tariff on imported buttons imposed by the tariff bill of 1890. This levied a duty of 2½ cents per line per gross on shell buttons and 25 per cent ad valorem. In the customs act of 1897 the tariff on pearl buttons was fixed at 1½ cents per line per gross and 15 per cent ad valorem.

The first person to engage in this business was Mr. J. F. Boepple, who had for many years been similarly engaged in Hamburg, Germany. On account of an abundance of suitable mussels in its vicinity, Muscatine, Iowa, was selected as the site of the first factory and has now become an important center for button manufacturing. Other towns on the Mississippi and its tributaries from time to time established works, until in 1898 there were 21 communities in Iowa and Illinois in which buttons

were made. A remarkable development of the business was witnessed in 1898, no less than 36 factories being established during the first six months of that year.

It is reported that some time before the establishment of a permanent industry at Muscatine, an effort was made to maintain a factory on the Tennessee River; this, howevei, was unsuccessful and was soon abandoned.

Button-making is one of the principal businesses along that part of the Mississippi between Iowa and Illinois. It gives employment to large numbers of people, who would otherwise be idle, at what are considered good wages for such labor. It also supports a very important fishery, at which many hundred persons make a living. Besides the people thus directly connected with the business, many others in more than a score of towns are benefited, including merchants, machinists, boatmen, draymen, and transportation companies.

Other important features of the Mississippi River button industry are the transformation of a hitherto useless product into a valuable commodity and placing it on the markets at reasonable prices.

NUMBER, LOCATION, AND DESCRIPTION OF THE FACTORIES.

During 1897 and 1898 (to July 1) button factories were located at the following places on the Mississippi River, in Iowa and Illinois, the lowermost point being Fort Madison, Iowa, and the uppermost Sabula, Iowa:

Iowa: Buffalo, Clinton, Davenport, Fort Madison, Muscatine, and Sabula.

Illinois: Albany, Andalusia, Cordova, Keithsburg, New Boston, Oquawka, and Port Byron.

The following table shows the growth of the button industry of the section of the Mississippi in question, the number of factories established each year being given:

Years when button factories were established on the Mississippi River in Iowa and Illinois.

Year.	Muscatine, Iowa.		Other places in Iowa.		Places in Illinois.		Total.	
	Complete plants.	Saw works.	Complete plants.	Saw works.	Complete plants.	Saw works.	Complete plants.	Saw works.
1891	1						1	
1892								
1893								
1894								
1895	1		2				3	
1896								
1897	3	3	1		1	1	5	4
1898 (to July 1)		25	2	2		7	2	34
Total	5	28	5	2	1	8	11	38

By far the larger number of these factories are small establishments at which only "rough blanks" are sawed; many of them should hardly be dignified by being called factories. In 1898 only 11 of them, located in Muscatine, Davenport, Clinton, Sabula, and Keithsburg, were plants where finished buttons were made.

At Muscatine there were 8 button-making establishments in operation in 1897, 6 of which began work in that year. By July 1, 1898, there were 33 factories in operation, and in the latter half of the year a number of others were opened. At other places named there were 5 factories in 1897, and 16 in the first half of 1898.

A GLIMPSE OF THE MUSSEL BUSINESS AT LECLAIRE, IOWA, WHERE THE MUSSELS ARE BOUGHT FROM THE FISHERMEN, CLEANED, AND THE SHELLS SENT BY RAIL AND WATER TO BUTTON FACTORIES. In the pile shown there are 350 tons of "niggerhead" shells.

BUTTON FACTORY, MUSCATINE, IOWA.

The number of factories in the various towns in operation in 1897 and 1898 are shown in the following table:

Location.	1897.			1898 (to July 1).		
	Complete works.	Saw works.	Total.	Complete works.	Saw works.	Total.
Muscatine, Iowa	5	3	8	5	28	33
Davenport, Iowa	2		2	2		2
Clinton, Iowa				1		1
Buffalo, Iowa					1	1
Fort Madison, Iowa					1	1
Sabula, Iowa	1		1	2		2
New Boston, Illinois					1	1
Keithsburg, Illinois	1	1	2	1	2	3
Oquawka, Illinois					1	1
Cordova, Illinois					1	1
Port Byron, Illinois					1	1
Andalusia, Illinois					1	1
Albany, Illinois					1	1
Total	9	4	13	11	38	49

In addition to the foregoing factories along the Mississippi in Iowa and Illinois, to which this report especially relates, in 1898 there were factories at the following places in those States at which mussel shells from the Mississippi were utilized: Cedar Rapids, Vinton, and Charles City, Iowa, on the Cedar River; Coralville, Iowa, on the Iowa River; West Liberty, in the western part of Muscatine County, Iowa; What Cheer, Keokuk County, Iowa; Oskaloosa, Mahaska County, Iowa, and Aledo, Mercer County, Illinois. Other button factories which get all or part of their raw material from the Mississippi are reported to be located in Chicago, Illinois; Cleveland and Cincinnati, Ohio; Janesville, Wisconsin, and Omaha, Nebraska.

The factories at which the finished buttons are made are, as a rule, specially constructed 2-story brick buildings of considerable size, having a cost value of $5,000 to $30,000, which sum includes land, buildings, machinery, and general equipment. A few of them occupy parts of mills or machine shops. Some of the plants at which only blanks are sawed are also in special brick or wooden buildings, but most of the "saw works" are in connection with machine shops or in improvised outbuildings of private residences, some of the smaller ones being in simple sheds. A single room is sufficient for the mere sawing of the rough blanks, but the various steps in the manufacture of the complete buttons necessitate a number of rooms and make the factory a very elaborate establishment, with the heavier machinery and rougher work on the first floor, and the different finishing processes on the upper floor.

The essential work at all the factories is done by machinery. At all the larger and many of the smaller establishments, the motive power is steam or electricity; some obtain their electric power from the city electric plant, some have independent dynamos, some have steam engines, and some use the power of adjoining machine shops or mills. A gasoline engine, of 2 or 3 horsepower, furnishes the motivity for the saws at several of the small works, and foot power is also employed in a few places.

BUTTON-MAKING MACHINERY.

The business of supplying the factories with the necessary special machinery has become very important in Muscatine. The facility with which the cutting machines may be obtained and their comparatively small cost have been leading factors in the establishment of many of the button factories. At some large machine shops

practically the entire work now consists in making and repairing apparatus used in button manufacturing and mussel fishing.

The following, taken from a Muscatine paper, illustrates the cost of the necessary machinery and the apparent profits of the machinists:

As so much has been said regarding the cost of producing pearl buttons and so little about the cost of the necessary machinery required in their manufacture, attention is called to the following schedule, figuring on a 10-saw basis.

The cost of machinery and the price that it has been selling for allow a very handsome profit, and the business is now looked on as a money-making proposition, which is not overdone as some lines, but affords an opening for new concerns to engage in.

Grinding machine:		
Casting	$3.50	
Steel	.30	
Machine screws	.15	
Machinist, 10 hours work	2.00	
Helper, 10 hours' work	1.00	
Emery wheel	4.00	
Fan	5.00	
Automatic beveling machine	22.50	
Total	38.45	
Two grinding machines with automatic beveling connection		$76.90
Turning machine:		
Casting	4.00	
Steel	.60	
Machine screws	.30	
Machinist, 20 hours' work	4.00	
Helper, 20 hours' work	2.00	
Automatic tool sharpener and emery wheel	2.70	
Total	13.60	
Five turning machines		68.00
Cutting machine:		
Castings	$2.80	
Steel	.30	
Machine screws	.10	
Machinist, 15 hours work	3.00	
Helper, 15 hours' work	1.50	
Total	7.70	
Ten cutting machines		$77.00
Drilling machine:		
Casting	4.00	
Steel	.60	
Machine screws	.30	
Machinist, 20 hours' work	4.00	
Helper	2.00	
Total	10.90	
Five drilling machines		54.50
One sorting machine, comprising the rollers and cups		27.50
Shafting, pulleys, and belting		123.00
Polishing fixtures, consisting of tumblers, urns, etc		60.00
One sizing and grading machine		19.50
Total outfit		506.40

Cutting machines that cost $7.70 generally sell for $28. The cost of a 10-saw plant complete, $506.40; running expenses of manufacturer to produce this from raw material, $60; total, $566.40. Usual selling price for such an outfit as described above, from $2,500 to $3,000.

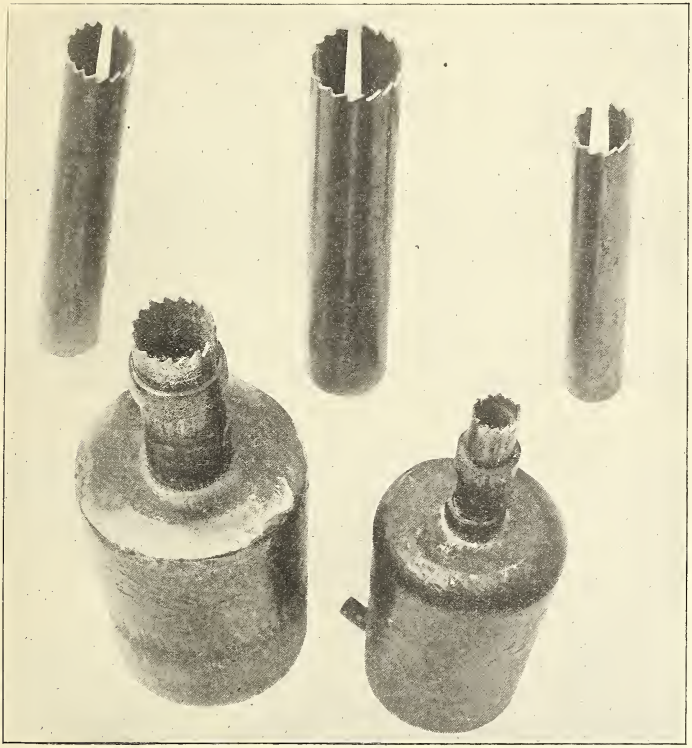
METHODS PURSUED IN THE BUTTON INDUSTRY.

The mussel shells, as purchased from the fishermen, are hauled from the boats to the factories in drays or wagons either owned or hired by the manufacturers or in vehicles belonging to the fishermen. At the factory the shells are stored in covered sheds, the different kinds usually being kept in separate bins. Preparatory to being used, the shells are sorted into sizes by boys. Usually three sizes of "niggerheads" are recognized. Another preliminary step is the soaking of the sorted shells in barrels of fresh water for three to six days to render them less brittle. Even when only a few hours out of the river the shells become dry and brittle. It is necessary that they be used while wet, otherwise they crumble or split under the saw.

The next step is the cutting or sawing of the rough blanks. Each cutter has a pile of selected shells at hand, and, in the large factories, is kept supplied by boys. Niggerhead shells are usually held with special pliers while being cut; these grasp the circumference of the shell and enable cutters to retain it fast while holding the shell at right angles to saw. Some sawers have the hand gloved or mittened, and use no pliers or pincers. At the more extensive plants a fine jet of water plays on the shell, as the saw revolves, in order to prevent the formation of dust and to keep the shell cool. The dust is very irritating to the respiratory passages and eyes of the

cutters, and at some of the factories it is drawn into a tube by a current of air. The cutters in the smaller works often cover the mouth and nose with a cloth.

The saws are made of flat steel strips about 2 inches wide, and of various lengths corresponding to the sizes of the buttons. These strips, after being provided with fine teeth along one of the sides, are accurately bent into a cylindrical form and



Saws and sawholders used in making buttons.

fitted into heavy iron holders; the latter are adjusted to a lathe in which they revolve on a horizontal axis. As the blanks are cut they pass back into the saw and holder and drop into a box beneath the saw.

From the cutting machines the blanks are taken to a weigher and recorder, who credits each man with the number of gross he cuts.

In all branches of the button industry a gross is considered as consisting of 14 dozen, in order to make allowance for the imperfect or defective buttons that are liable to be produced at every stage of the business from the cutting of the rough blanks to the sewing of the finished buttons on cards.

By far the largest number of factories produce only rough blanks, which are sold to a local finishing plant or sent to large concerns in the East, some of which have established their own "saw works" on the Mississippi.

The next step in the making of the complete button is the dressing or grinding of the back of the blank, to remove the skin and make an even surface. To accomplish this each blank has to be held with the finger against a revolving emery wheel.

Turning or facing is the next step. This, which is similar to the preceding, gives to the front of the button its form, including the central depression. This is followed by the drilling of 2 or 4 holes for the thread.

The button is now complete with the exception of the polishing process; this brings out the natural luster which has been lost in grinding, and which gives to these buttons their chief value. The buttons are placed in mass in large wooden kegs, known as tumblers, in which they are subjected to the action of a chemical fluid at the same time that the tumblers are revolving on a horizontal shaft. By mutual contact, combined with the effect of the fluid, the buttons become highly lustrous, while the fluid is churned into a milky froth. After being washed and dried the buttons go to rooms where they are sorted into sizes and grades of quality, and then sewed on cards and packed in pasteboard boxes.

The daily capacity of the largest factories is 700 to 1,000 gross of finished buttons.

At Muscatine there is a small business in treating buttons to make them resemble "smoked pearl." This is a secret chemical process. The buttons so treated are usually those which exhibit defective coloration, such as yellow blotches, which would prevent their sale as first-class goods, but are otherwise perfect.

The unit of measure of the size of buttons is the line, which is one-fortieth of an inch. The buttons manufactured on the Mississippi are from 12 to 45 lines in diameter. The largest buttons (40 to 45 lines) are made from "niggerheads."

Following are the quantities of various-sized blanks that may be cut from 100 pounds of average-sized "niggerheads": 16-line, 28 to 34 gross; 18-line, 30 to 32 gross; 20-line, 24 to 29 gross; 22-line, 15 to 20 gross; 24-line, 12 to 15 gross.

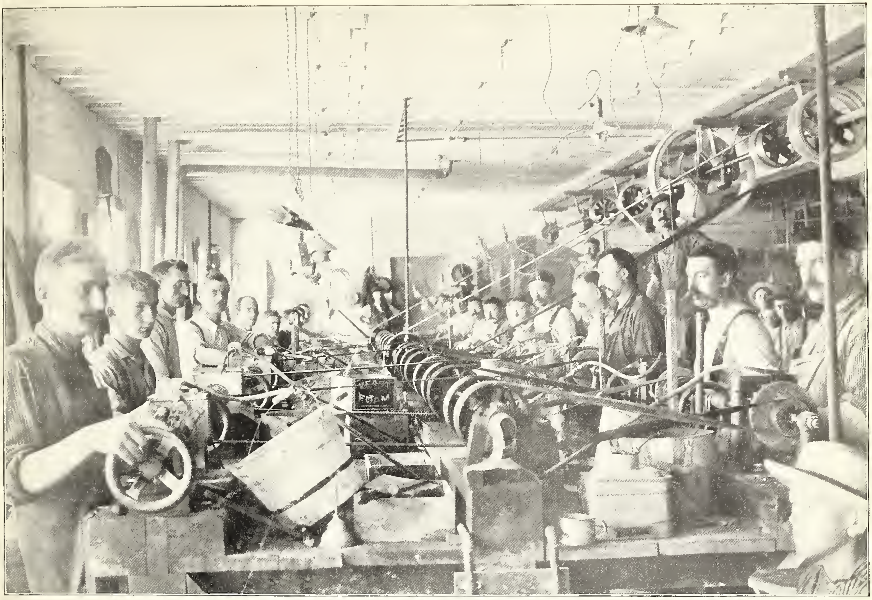
Sand shells of medium size and thickness yield the following, per 100 pounds: 20-line, 64 gross; 26-line, 31 gross.

A medium-sized "niggerhead" produces 4 or 5 18-line or 20-line blanks. From the large shells 8 or 10 blanks may be cut. Sand shells average 12 20-line buttons. Larger sand shells yield 16 to 20 buttons. The largest deerhorns may sometimes be cut into 25 or 30 blanks; one shell is figured from which 28 20-line blanks were sawed.

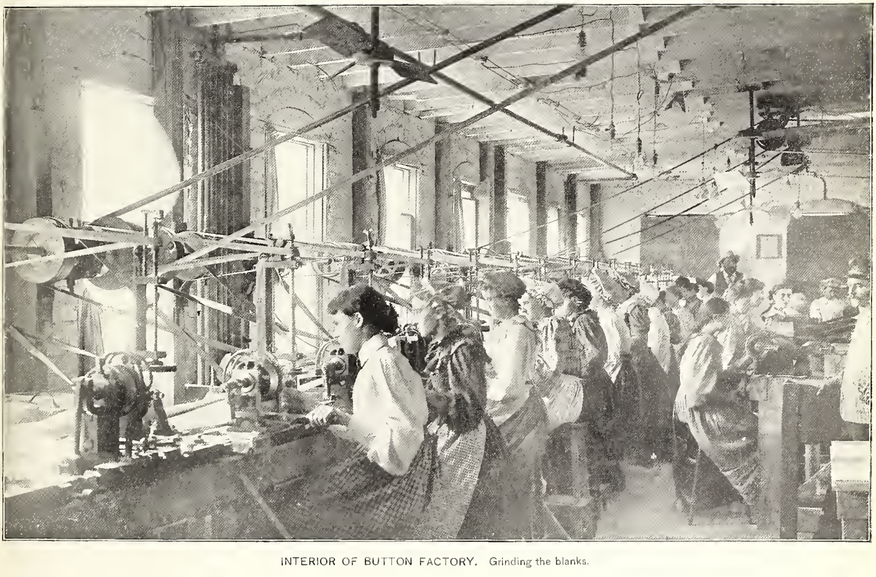
THE FACTORY HANDS AND THEIR WAGES.

At the button factories on the Mississippi River in Iowa and Illinois a large number of persons are employed at wages generally regarded as good. Besides men, who have the more arduous and important duties, many boys and girls, who would otherwise be idle, are given employment.

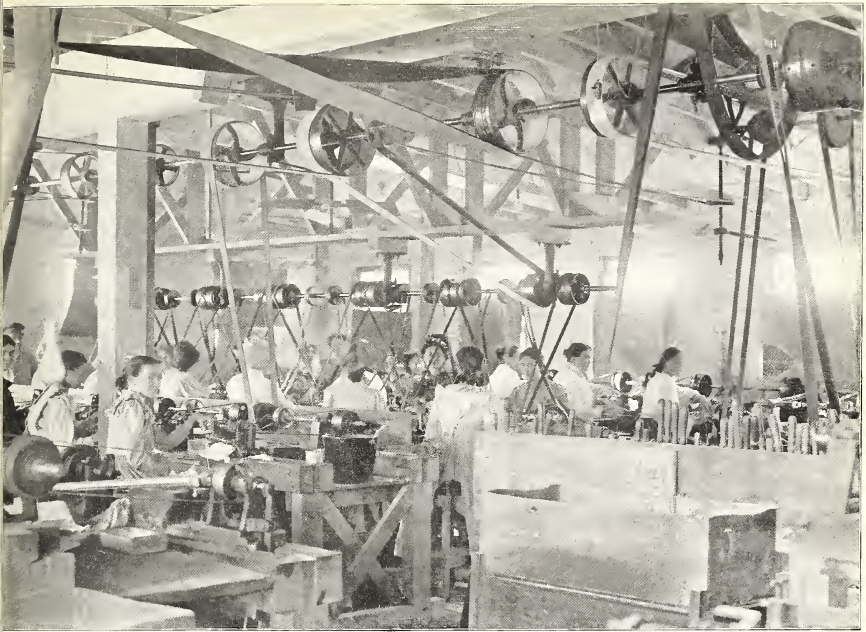
In 1897 the employees in the button factories of Muscatine numbered 532; in the first half of 1898 the number had increased to 829; at the other places embraced in this report, 282 persons were employed in 1897 and 605 in the first six months of 1898,



INTERIOR OF BUTTON FACTORY. Sawing the rough blanks.



INTERIOR OF BUTTON FACTORY. Grinding the blanks.



INTERIOR OF BUTTON FACTORY. Drilling holes in the buttons

INTERIOR OF BUTTON FACTORY. Sorting the buttons, sewing them on cards, and packing in boxes

giving a total of 814 for 1897 and 1,434 for 1898. Of the latter, 1,042 were males and 392 females.

In the factories in which finished buttons are made, from 30 to upward of 200 people are employed, the males and females being in about equal numbers. The factories which simply produce the "rough blanks" employ only males, the number of whom averages only 14, and only one such factory employs more than 30 persons. This is an extensive establishment in Muscatine, having 110 hands in 1898.

Taking a large Muscatine factory as an example, the following are the various capacities in which the employees are engaged:

Nature of employment.	Number.
Cutters (all men)	55
Dressers and grinders (boys)	30
Facers (girls)	30
Drillers (girls)	32
Sorters and carders (girls)	36
Packers, etc. (girls)	15
General employees (men and boys)	15
Managers and clerks	3
Total	216

The best wages are received by the cutters, who are always men. In the larger factories they are paid 5 to 10 cents a gross (14 dozen) for "rough blanks," according to size. Skilled men can cut from 150 to 200 gross of blanks per week, and can earn \$15, but the average is \$8 to \$10.

While the cutters are paid by the gross, the quantity is determined by weight, as too much time would be lost in actually counting the blanks. A scale of weights per gross for blanks of different sizes is established. Thus, 1 gross of 20-line sand-shell blanks weighs 1½ pounds.

The pay of grinders is 1½ to 2½ cents a gross, or from \$5 to \$7 a week.

Dressers are paid 1 to 2 cents a gross, and make about \$4 50 a week.

Facers receive 2 to 3 cents a gross, and earn \$4 to \$6 a week. They are usually young women.

Drillers are paid 1¾ to 3½ cents a gross, and make about \$5 a week.

Those who sort the buttons into lots homogeneous as to size and quality are paid by the day, and earn about \$3.75 a week.

The price paid for sewing the buttons on cards is 3 cents a gross. The girls who do this work make \$4 or \$5 a week.

Those who pack the carded buttons in boxes and the boxes in the shipping cases are paid \$5 a week.

PRICES AND MARKETS FOR BUTTONS.

It was very generally reported in 1898 that the button industry was being overdone by the establishment of numerous small factories at which rough blanks were sawed. Many persons engaged in the business without proper equipment or experience, and the very short life of some of the factories shows that the remarkable increase in the business in 1898 was not a healthy growth. Some of the output was not of standard quality, and a general lowering of prices has been a result.

The prices received for rough blanks in 1897 and 1898 ranged from 10 to 20 cents a gross, depending on size and quality. The prices corresponded rather closely with the sizes, an 18-line blank, for instance, bringing 18 cents a gross; but as a rule the

prices were less than the figures representing the sizes of the blanks, being 1 to 3 cents "under the line." The average size of the rough blanks was 18 or 20 lines, and the average value per gross was 16 or 18 cents.

The wholesale prices received for the finished buttons have been a little over double those of the rough blanks of the same sizes. The average prices for complete buttons in 1897 and 1898 were 35 to 40 cents a gross. The following were the ruling prices for buttons of the stated sizes and qualities during the past year as furnished by one of the leading firms:

First grade.		Second grade.		Third grade.	
Size.	Per gross.	Size.	Per gross.	Size.	Per gross.
	Cents.		*Cents.*		*Cents.*
16-line	55	16-line	50	16-line	40
18-line	60	18-line	55	18-line	45
20-line	65	20-line	60	20-line	50
22-line	70	22-line	65	22 line	55
24-line	75	24-line	70	24-line	60

In addition to the foregoing, a superfine button is manufactured which sells for about 15 cents per gross more than the first grade, and a cheap button, used chiefly by shirt-makers, which brings from 25 to 30 cents a gross.

There was naturally some difficulty at first in putting on the market buttons made from our native fresh-water shells, but the demand was rapidly developed, as the quality and price of the buttons became known, and at present Mississippi River buttons are sold in every State and Territory and in Canada. It is reported that orders have recently (1899) come from England.

UTILIZATION OF WASTE.

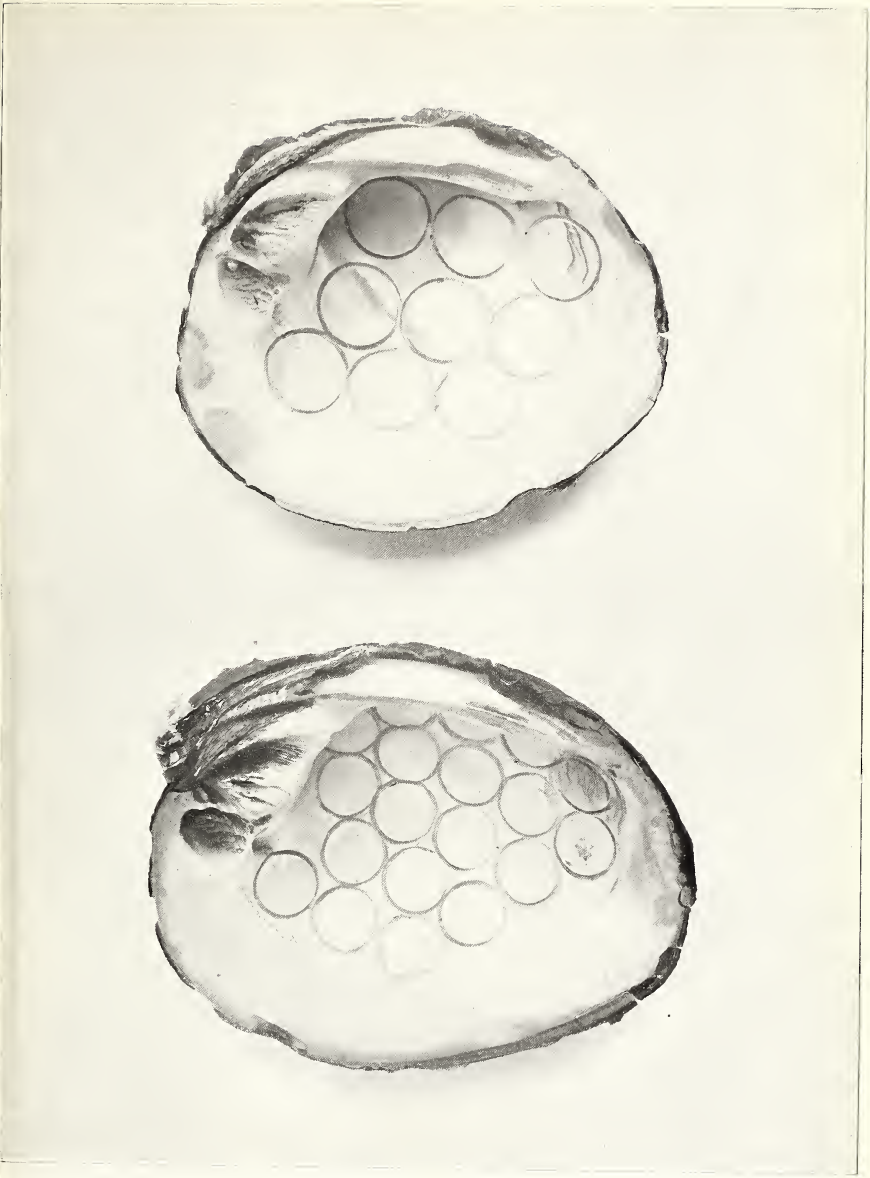
In sawing the blanks a large part of the shell can not be used, as it is incapable of being made into merchantable buttons. The relatively thin margin of the valves and the thick beak or umbo furnish the principal waste. The amount of unserviceable raw material is extraordinarily large, although it varies with the different species and to some extent with the different factories. In the aggregate it probably represents over 75 per cent of the weight of shells handled, and, according to the testimony of the manufacturers, with the principal mussel employed, the "niggerhead," from 85 to 93 per cent, by weight, is discarded in sawing blanks, the average loss of material being about 90 per cent. In facing, grinding, drilling, and polishing the blanks, and in defective blanks, there is a further waste, estimated at 20 to 50 per cent of the original weight of the blanks. With "sand shells," "deerhorns," and some other species, the waste is much less, amounting to probably only 50 per cent, all told.

As the accumulation of waste soon proves a nuisance, the factory owners are naturally desirous of finding some uses to which it can be put. If a market could be found for it, even at a very low price, it would be a decided boon to the industry. Many of the manufacturers feel that it has a value, but they have not been able to discover a way in which to dispose of it for any financial consideration, and practically the only use to which it has been put has been in making roads, the municipal authorities hauling it from the factories. As a rule, the manufacturers are glad to get rid of it in this way, and some of them have even paid to have it taken away.

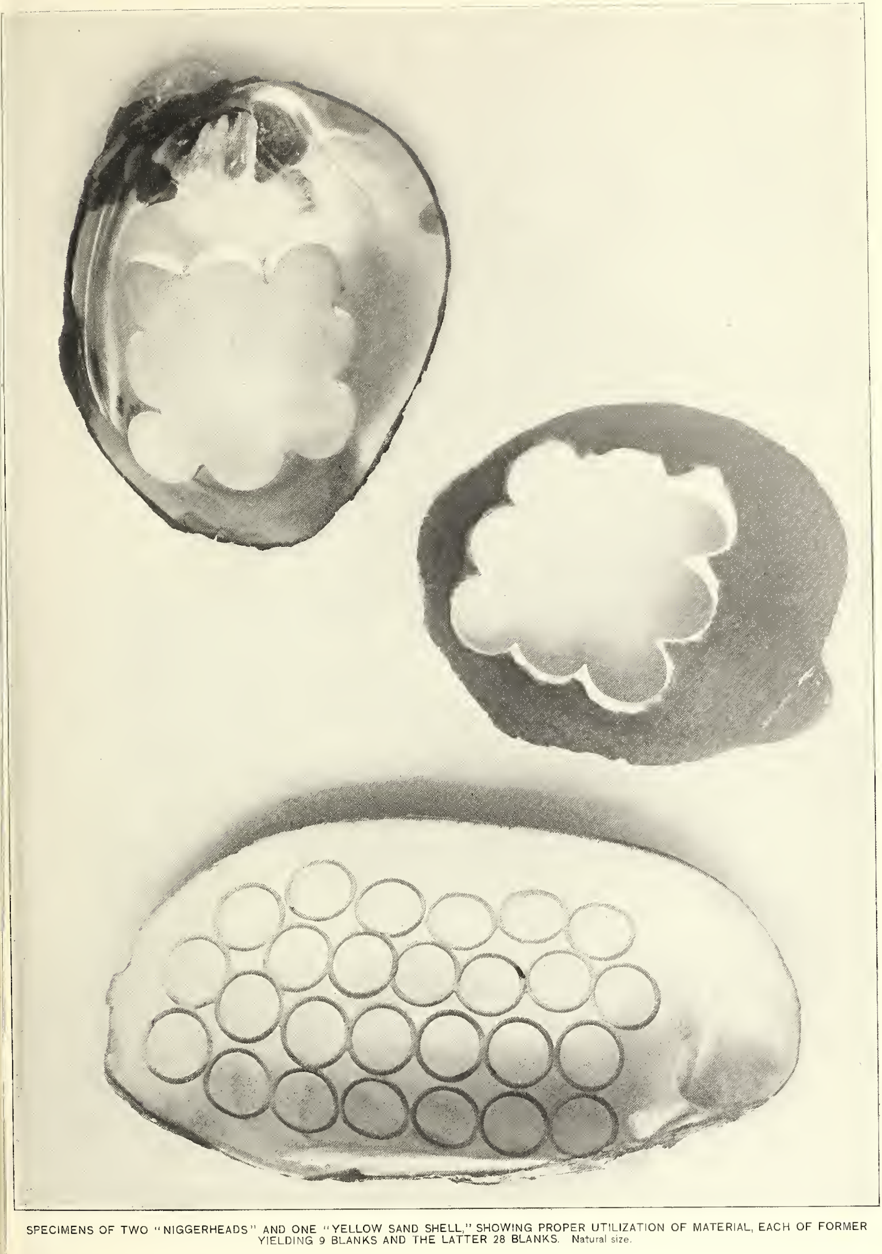
Farmers occasionally call for small quantities of finely broken shells for use as food for chickens and turkeys, but the demand is very limited. In the opinion of the United States Department of Agriculture, the value of the shells for such a purpose is

SAMPLE OF "NIGGERHEADS" ILLUSTRATING WASTE IN SAWING BLANKS. Natural size.

These shells were picked from waste heaps of button-makers. In the six largest shells the waste of raw materials is over 60 per cent. The small shell is an example of the immature mussels that are being destroyed.



LARGE "NIGGERHEADS" (*Quadrula ebena*) SHOWING POSSIBLE NUMBERS OF BLANKS THAT MAY BE SAWED (9 IN THE UPPER FIGURE AND 19 IN THE LOWER). Natural size.



SPECIMENS OF TWO "NIGGERHEADS" AND ONE "YELLOW SAND SHELL," SHOWING PROPER UTILIZATION OF MATERIAL, EACH OF FORMER YIELDING 9 BLANKS AND THE LATTER 28 BLANKS. Natural size.

considerable, and at least one factory has introduced a special machine for reducing the shells to small fragments of uniform size, with rounded edges.

In sawing, grinding, and drilling the blanks, a fine white powder results. Much of this has been saved by the button manufacturers in the hope that some use may be found for it. Small quantities have from time to time been given to farmers to experiment with as a fertilizer, but no demand for it has been created, and its value in this respect has only been conjectural. In order to obtain an authoritative opinion as to the feasibility of employing this powder as a fertilizer, the U. S. Commissioner of Fish and Fisheries submitted a sample to the Secretary of Agriculture, who reported as follows:

> The fine-ground powder, which is the refuse of the pearl-button industry, transmitted to me in connection with your letter, has been examined by the chemist of the Department and found to be almost pure carbonate of lime. It will prove a valuable fertilizing material for stiff clay soils and for other soils deficient in lime. In the fine state of subdivision in which it exists, it could be applied directly to the soil without further preparation. I should advise persons engaging in this industry to communicate with the directors of the agricultural experiment stations of their respective States in regard to the utilization of this waste material for fertilizing purposes.

This powder without further preparation is undoubtedly excellent for polishing coarse metalware, and, if screened to remove any larger particles, might even be used for cleaning and polishing silverware, cutlery, etc.

The use of the powder in stucco-work has also been suggested.

AVOIDABLE WASTE OF RAW MATERIAL.

Although, under the most favorable circumstances, there is a very large loss of material that can not be avoided, at the same time there is a certain amount of preventable waste that in the aggregate must represent many thousand gross of buttons annually. This waste consists in the failure of the sawers to utilize all the available shell, and naturally varies greatly with different men and different factories.

The accompanying illustrations of shells that were picked almost at random from the discarded heaps of certain Muscatine factories clearly indicate, even to a person not versed in the button business, the unnecessary waste of material, and render scarcely needful the presentation of contrast illustrations, showing the buttons that may be cut from such shells.

From the waste heap of one manufacturer 13 "niggerhead" shells were picked at random; from these 26 rough blanks had been cut, of which 19 were capable of being made into salable buttons. The same shells were taken to another factory where 48 additional good blanks were cut. Here was an avoidable loss of 65 per cent.

Another example of waste, and probably an extreme one, was recorded in a Muscatine paper in August, 1898: A button manufacturer picked up 16 shells from a pile that was being spread on a road. From these 31 blanks had been cut. He took the discarded shells to his factory and sawed out 152 merchantable blanks. In other words, 83 per cent of the raw material had been wasted.

It is not to be supposed that the manufacturers sanction the waste of material in cutting blanks. The trouble is that the cutters are often careless or inexperienced, and can not always be kept under the supervision of the foreman or manager. As the cutters are paid for the blanks they cut, it is decidedly to their personal advantage to get as many blanks as possible out of each shell they handle, as there is loss of time in throwing one shell away, taking a new one, and fitting it to the saw.

STATISTICS OF THE BUTTON INDUSTRY.

In the following series of tables the extent of the button industry of the Mississippi River is shown for the calendar year 1897 and the first six months of 1898. At the time of the investigation the season was not over and no complete statistics for 1898 could be obtained. It should therefore be borne in mind that the figures given for that year represent less than half the extent of the business, as a number of new factories were established after July 1.

Outside of Muscatine, there are only from one to three factories in any one place; and in order that private interests may not be disclosed, the statistics for all the factories in each State are combined.

The 814 persons employed in 1897 are shown to have received $157,650 in wages, while the 1,434 employed in the first half of 1898 were paid $133,980.

The capital invested in the button-manufacturing business, in buildings, machinery, equipment, and land, was $118,300 the first year and $171,435 the second.

The cost of raw materials used in button-making was $40,408 in 1897 and $37,008 in 1898, these amounts representing 3,602 tons and 3,641 tons, respectively.

The manufactured products consisted of 463,200 gross of buttons and 673,200 gross of blanks in 1897 and 399,489 gross of buttons and 761,113 gross of blanks in 1898. The market value of the buttons and blanks was $243,655 in 1897 and $252,570 in 1898.

Persons employed and wages paid in the button industry of the Mississippi River in 1897 and 1898

Localities.	Male		Female.		Total.		Wages.	
	1897.	1898.	1897.	1898.	1897.	1898.	1897.	1898.
Muscatine, Iowa	334	590	198	239	532	829	$120,100	$87,890
Other places in Iowa	87	168	62	123	149	291	11,800	23,190
Places in Illinois	105	284	28	30	133	314	25,750	22,900
Total	526	1,042	288	392	814	1,434	157,650	133,980

Capital invested in the button industry of Iowa and Illinois in 1897 and 1898.

Localities.	1897.	1898.
Muscatine, Iowa	$77,300	$98,705
Other places in Iowa	23,000	34,000
Places in Illinois	18,000	38,730
Total	118,300	171,435

Quantities and values of mussel shells used in the button industry of the Mississippi River in 1897 and 1898.

Localities where used.	Niggerheads.		Sand shells.		Muckets.		All others.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1897.										
Muscatine, Iowa	2,309.00	$24,184	164.00	$5,410	31.75	$187	17.25	$502	2,522.00	$30,283
Other places in Iowa	450.00	3,675							450.00	3,675
Places in Illinois	525.00	5,250	50.00	1,000	50.00	100	5.00	100	630.00	6,450
Total	3,284.00	33,109	214.00	6,410	81.75	287	22.25	602	3,602.00	40,408
1898.										
Muscatine, Iowa	2,216.00	24,175	20.60	547	26.25	154	10.39	149	2,273.24	25,025
Other places in Iowa	741.00	5,865	2.50	15			.50	2	744.00	5,882
Places in Illinois	572.00	5,591	50.00	500			2.00	10	624.00	6,101
Total	3,529.00	35,631	73.10	1,062	26.25	154	12.89	161	3,641.24	37,008

Quantities and values of finished buttons and rough blanks made in the button factories on the Mississippi River in 1897 and 1898.

Years and localities.	Finished buttons.		Rough blanks.		Total buttons and blanks	
	No. of gross.	Value.	No. of gross.	Value.	No. of gross.	Value.
1897.						
Muscatine, Iowa	313, 200	$109, 270	418, 200	$66, 385	731, 400	$175, 655
Other places in Iowa	110, 000	33, 000			110, 000	33, 000
Places in Illinois	40, 000	10, 000	255, 000	25, 000	295, 000	35, 000
Total	463, 200	152, 270	673, 200	91, 385	1, 136, 400	243, 655
1898.						
Muscatine, Iowa	177, 696	66, 554	541, 120	84, 331	718, 816	150, 885
Other places in Iowa	195, 793	66, 767	48, 000	6, 040	243, 793	72, 807
Places in Illinois	26, 000	8, 000	171, 993	20, 878	197, 993	28, 878
Total	399, 489	141, 321	761, 113	111, 249	1, 160, 602	252, 570

RECOMMENDATIONS.

In view of the very general desire of those pecuniarily interested in this industry that some recommendations be made by the U. S. Fish Commission regarding the measures that seem necessary for preventing the further depletion of the mussel beds and the consequent curtailment of all branches of the business, the following suggestions are submitted. It should, however, be understood that the perpetuation of this important industry depends wholly on the joint action of the States concerned, and that the General Government and the U. S. Fish Commission are entirely without jurisdiction. The measures here advocated will, it is thought, be generally indorsed by the button-makers, a large majority of whom have been consulted regarding this matter; they should also commend themselves to the fishermen, who are vitally interested in having the mussel supply maintained.

1. *The gathering of small mussels should be prohibited, and a minimum legal size for each important species should be prescribed by law.*

The following are the minimum sizes of the principal shells that should be gathered, the figures referring to the greatest diameter: Niggerheads, $2\frac{1}{2}$ inches; sand shells, 4 inches; muckets, 4 inches.

A niggerhead $2\frac{1}{2}$ inches long will yield from 8 to 10 buttons 18 to 20 lines wide. A sand shell 4 inches long contains from 8 to 12 buttons of the same size, and a mucket about the same number.

2. *Immediately prior to and during their spawning season the principal species should be unmolested, and a close season should be fixed by law.*

The question of a close season presents some difficulties in view of the widely different spawning times of the various species of mussels. Probably the only species that need to be considered at this time are the "niggerhead," the "mucket," and the "sand shell." The normal spawning time of the "niggerhead" in the central part of the Mississippi Basin is late winter and early spring, chiefly the months of February, March, and April, while the spawning time of the "mucket" and "sand shell" is the summer and early fall.

The "niggerhead" is so much more important than all of the other species combined that protective legislation addressed to it alone would prove perhaps sufficient,

in view of the desirability of reducing the fishing season as little as practicable. The measure, therefore, which would probably accomplish the most good would be the establishment of a close time for "niggerheads" from January 1, or the time of ice formation in the Mississippi, to May 1.

3. *Provision should be made for the prevention of damage to the beds by sewage and factory refuse.*

The damage to the mussel beds in the Mississippi River in Iowa and Illinois by river pollution is to a large extent prospective, but adequate steps should be promptly taken to obviate this source of injury. The effect on animal life—especially that on the bottom—of the discharge of city and factory refuse into streams has hardly been considered by those interested in the preservation of the mussels, but it constitutes, perhaps, the most serious menace to the industry, in that the destruction wrought is inevitable and complete. Mr. Simpson thus refers to the injury to mussels which is caused by antiquated methods of disposing of refuse:

> The dumpings of manufactories and the sewage of cities turned into rivers is destroying not only the fish but the *Naiades*. In many places below factories or cities the water of the streams is offensively foul and wholly changed in color, so that practically no kind of organic life can exist in it. Along the Potomac and Shenandoah rivers, in the vicinity of Harpers Ferry and above it, are a number of mills which grind wood into a pulp for the manufacture of paper. These throw their sawdust and waste into the streams, and down below, where the water is comparatively quiet, it settles to the bottom, forming great masses of slushy, putrid matter, which is, no doubt, destructive to fish and unios. The city of Chicago is about to turn its sewage into the Des Plaines River, from which it will be carried into the Illinois River, a stream abounding with the very finest fresh-water mussels. There can be but little doubt that this great volume of filth and poison will destroy every *Naiad* in both of these streams, and possibly it may exert its deleterious influence even on the Mississippi River also.

4. *In order that local industries may be fostered and the catch of mussels made no larger than can be utilized by the factories in the vicinity, the matter of prohibiting the shipment of shells to distant States should be considered.*

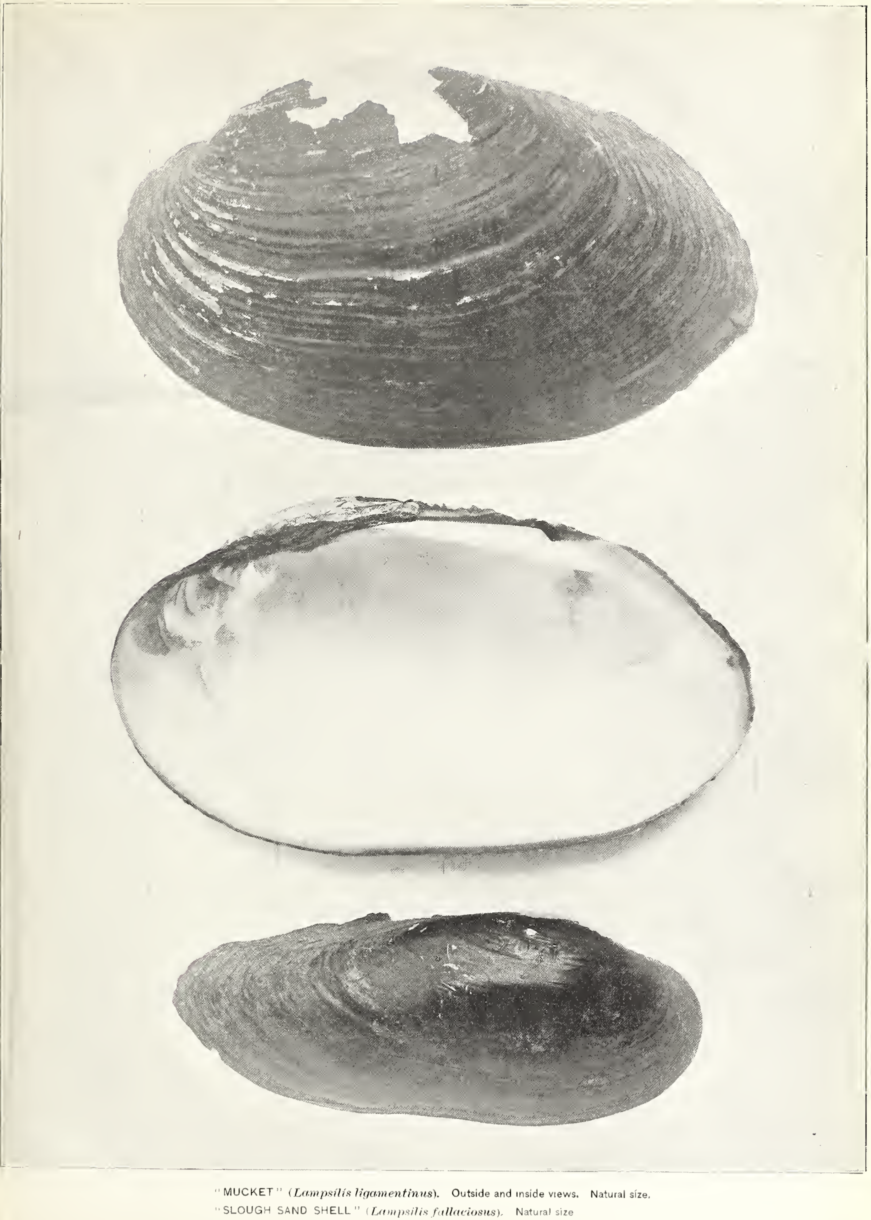
There is little doubt that the button factories now in operation in Iowa and Illinois can more than consume all the mussels that should be gathered from the section of the river under discussion. It is held by some persons having pecuniary interests at stake that the raw materials should be reserved for those who have invested their capital in permanent improvements and have established local industries, and that the continuance of the business should not be endangered by unrestricted shipment of shells to distant States and countries.

5. *Button manufacturers should exercise greater care in utilizing their shells in order to reduce the waste of raw material.*

This subject has already been sufficiently discussed.

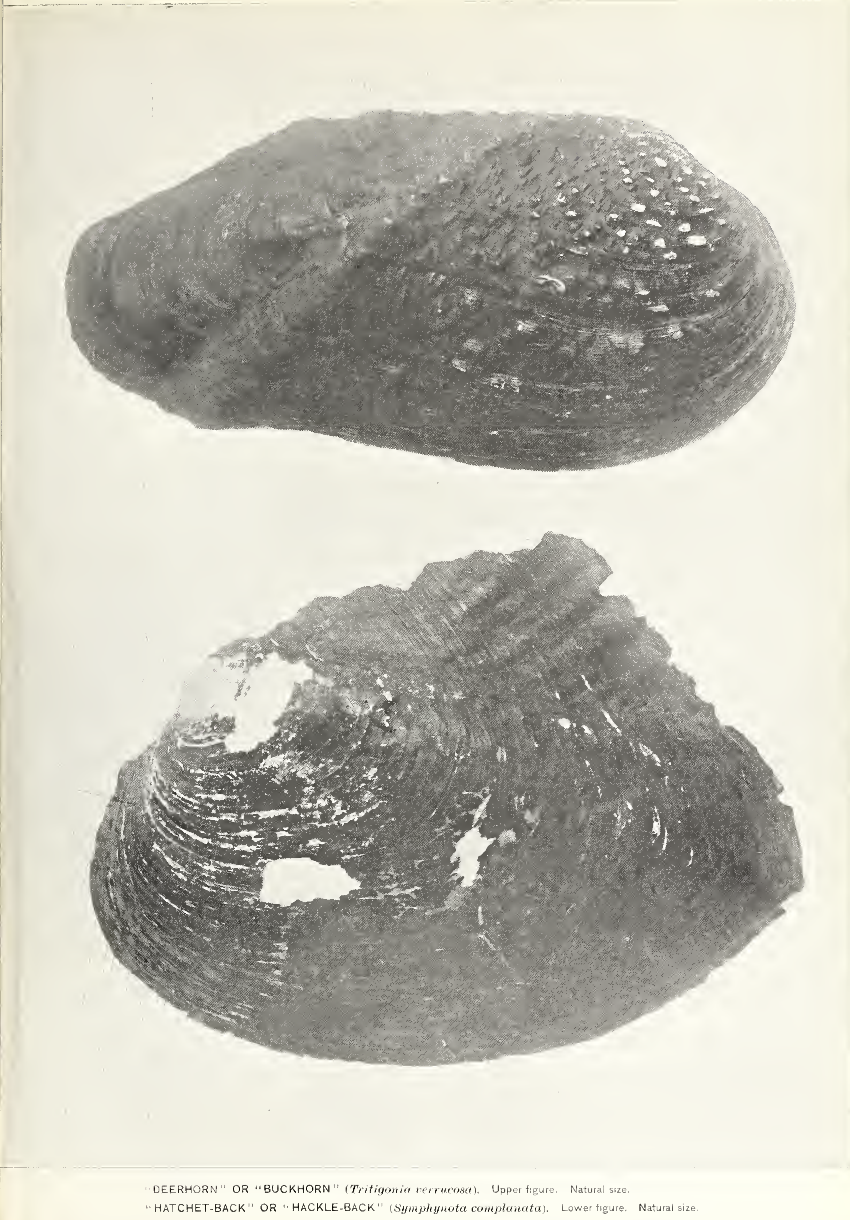
"NIGGERHEADS" (*Quadrula ebena*). Natural size

"YELLOW SAND SHELL" OR "YELLOW-BACK" (*Lampsilis anodontoides*). First figure a male, second a female. Natural size.
"BLACK SAND SHELL" (*Lampsilis rectus*). Lower figure. Natural size.

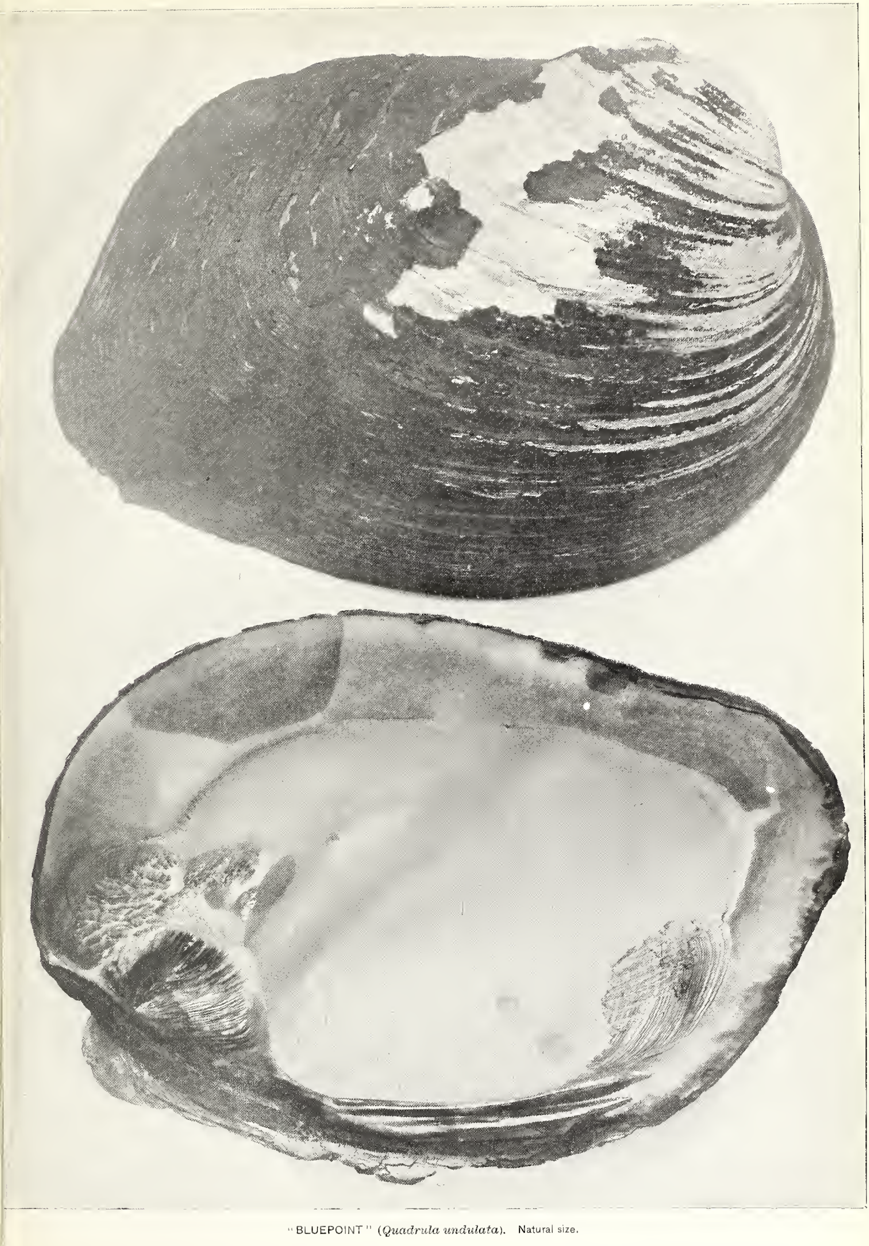


"MUCKET" (*Lampsilis ligamentinus*). Outside and inside views. Natural size.
"SLOUGH SAND SHELL" (*Lampsilis fallaciosus*). Natural size

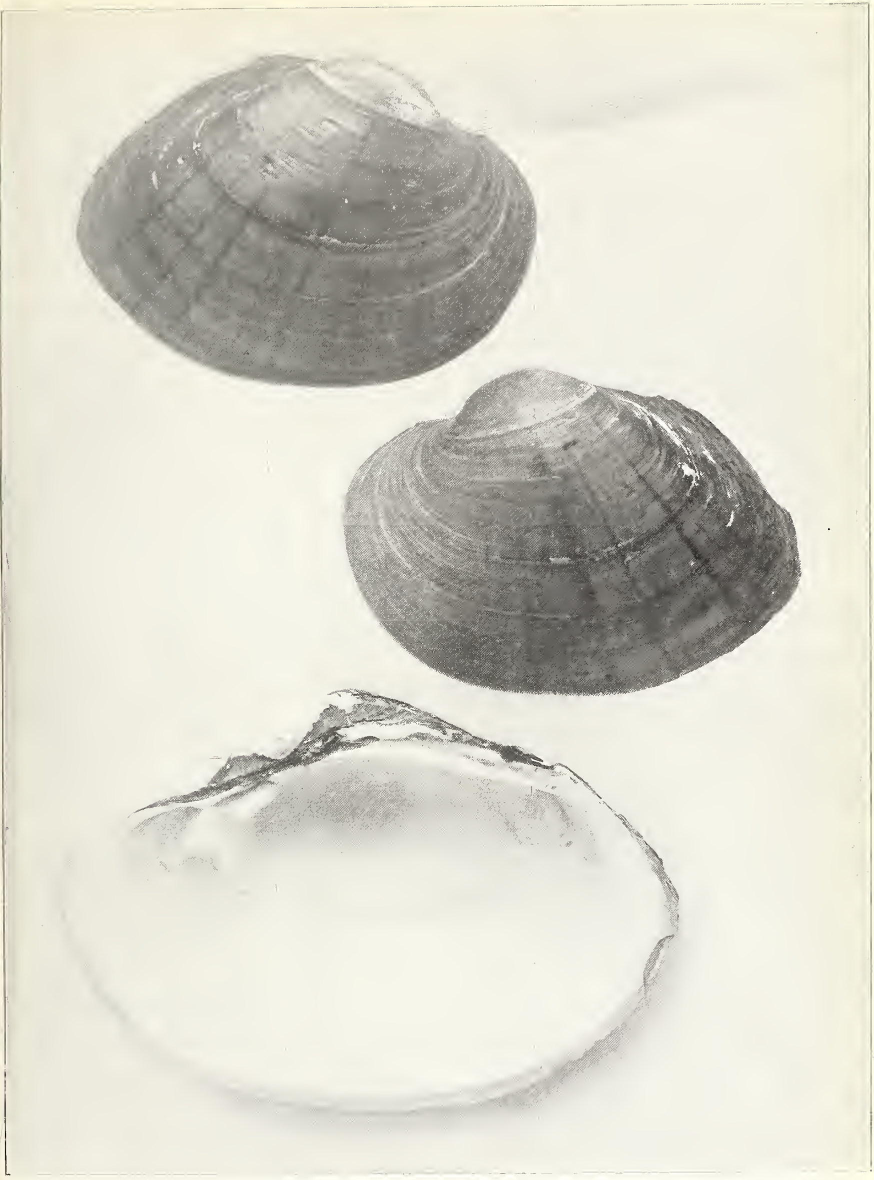
"BULLHEAD" (*Pleurobema æsopus*). "WARTY-BACK" (*Quadrula pustulosa*). Natural size.
"BUTTERFLY" (*Plagiola securis*). Outside and inside views Natural size.



"DEERHORN" OR "BUCKHORN" (*Tritigonia verrucosa*). Upper figure. Natural size.
"HATCHET-BACK" OR "HACKLE-BACK" (*Symphynota complanata*). Lower figure. Natural size.

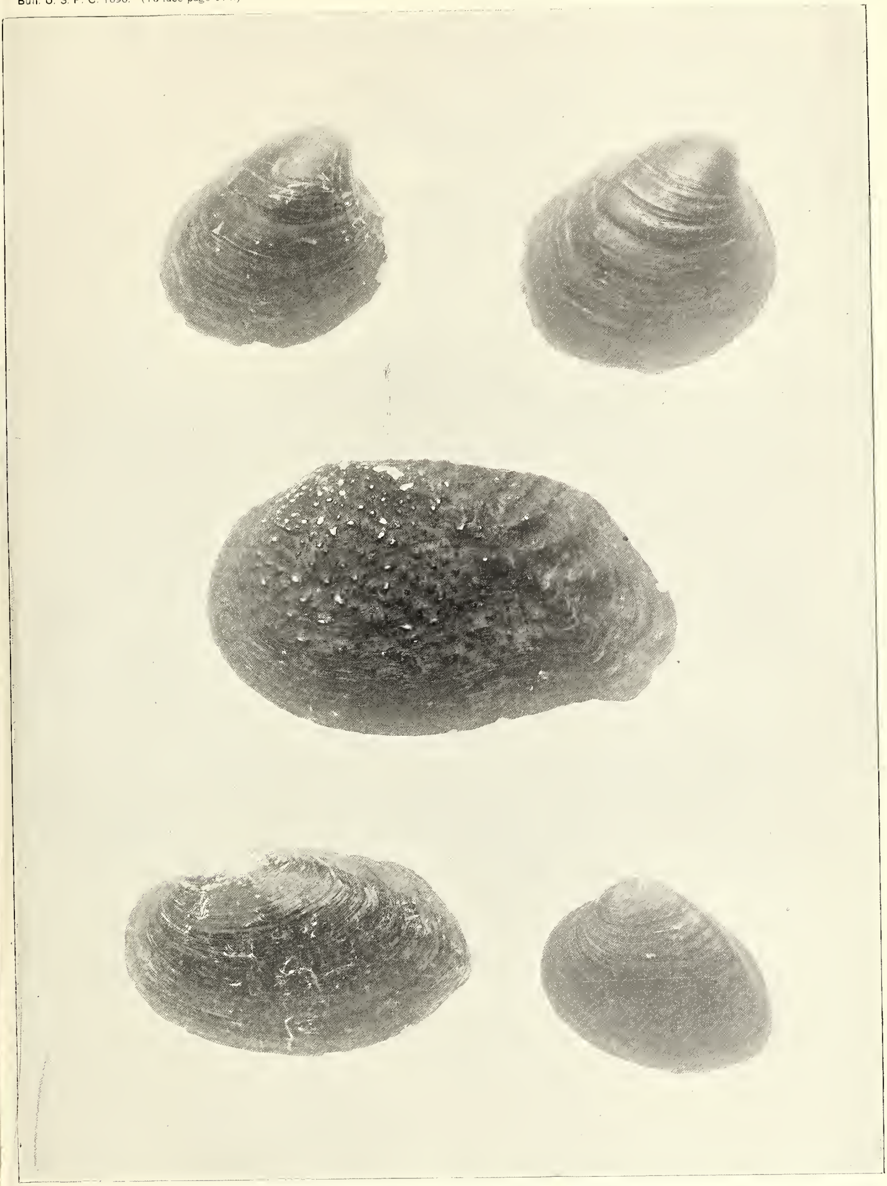


"BLUEPOINT" (*Quadrula undulata*). Natural size.



"POCKETBOOK CLAM" (*Lampsilis ventricosus*). Natural size.

"POCKETBOOK CLAM" (*Lampsilis capax*). Natural size.



SAMPLES OF UNDERSIZED MUSSEL SHELLS USED IN BUTTON MAKING. All figures natural size

Two upper figures "Niggerheads," central figure "Deerhorn," lower left-hand figure "Mucket," lower right-hand figure "Butterfly."

Contributions from the Biological Laboratory of the U. S. Fish Commission,
Woods Hole, Massachusetts.

THE PERIPHERAL NERVOUS SYSTEM OF THE BONY FISHES.

By C. JUDSON HERRICK,

Professor of Zoology in Denison University,
Associate in Comparative Neurology, Pathological Institute of New York State Hospitals.

For some two years past the writer has been engaged upon a microscopical examination of the cranial and first spinal nerves of the teleostean fishes. To any-one acquainted with the literature of the nervous system of the fishes it is apparent that great confusion prevails regarding the morphology of their peripheral nerves. Not only are the homologies with the higher and lower forms obscure, but even within the groups of fishes the variations in the courses of these nerves are so great as to complicate the problem enormously. Previous workers along these lines have, as a rule, either confined themselves to gross dissections, or, if the microscopical method has been used, such studies have usually been confined to the proximal or root portions of the nerves.

Now, by gross methods the topographical relations of the nerves can be and have been determined for most of the groups of larger fishes with precision. Indeed, the great monograph of Stannius in 1849 has covered this ground with remarkable completeness and accuracy. This method, however, leaves us almost entirely in the dark as to the composition of the several rami; for it is impossible to determine more than approximately what classes of sensory and motor fibers are included within each nerve, and even such an approximation is often out of the question. On the other hand, the microscopical study of the nerve roots and their nuclei within the brain is also unsatisfactory; for unless we know the exact peripheral distribution of each of these roots we may be led into grave errors of interpretation, as several of the most recently published researches in this field forcibly illustrate.

In view of these facts, the present demand, it seems to me, is for a minute and exhaustive study of the exact relations of the several nerve components through the entire courses of the several cranial nerves in a few typical fishes. The common silverside, *Menidia*, so abundant about Woods Hole and other points along the Atlantic coast, was chosen as the first type to be examined. These little fishes stand about midway between the physostomous and the physoclystous types of fishes, and may be regarded as relatively simple, generalized forms. Though the organs of special sense (eye and ear) are very highly developed, and in some other minor features there is considerable specialization, yet the nervous system, as a whole, is very simply and evenly developed, and conforms to the central position given to these fishes by the taxonomists.

Menidia is a favorable type for such study, not only on account of its central position and small size, but the tissues seem to react histologically better than those of some other fishes. Moreover the nervous system of the family *Atherinidæ* has not before been examined even by gross dissection, and several points have been brought out in the topography which are either new for teleosts or shed light on vexed morphological questions, such as the discovery of a pre-trematic branch of the facial nerve, a ramus ophthalmicus profundus of the trigeminus, and a true spinal accessory nerve emerging with the vagus to supply the trapezius muscle.

The research was conducted by means of reconstructions from serial sections cut through the entire head of the adult fish and stained by a modification of the Weigert method,* the aim being to trace each nerve component continuously from its nucleus of origin or termination in the brain through the root and ganglionic complex to its peripheral end. Thus, ultimately, the exact composition of each peripheral nerve and ganglionic complex would be given. This attempt has been crowned with a fair measure of success, and plots have been prepared to exhibit graphically the courses of the several kinds of fibers.

The doctrine of nerve components dates properly from the systematic separation of sensory and motor roots and the formulation of Bell's law. Gaskell's suggestive "four-root theory" of the nerves has been a stimulus to further advance, though probably that theory will not stand in exactly its original form. Our precise knowledge of the sensory components in the cranial nerves of lower vertebrates begins with Strong's paper on "The Cranial Nerves of the Amphibia" in 1895, and the present investigation was carried out upon the basis of that work. The cranial nerves of the fish which I have studied have reduced themselves to a plan which is so simple and so similar to what Strong found in the Amphibia that we are justified, I think, in regarding this arrangement in its main outlines as a type to which the nerves of all the higher fishes may provisionally be referred (see diagram). A careful study of nearly all of the existing literature supports this belief. At any rate this scheme will serve, it is hoped, as a basis for future work in the attempt to unify and correlate our knowledge of the nerves of the lower vertebrates.

The spinal nerves.—Following Gaskell, four components are now generally recognized in the spinal nerves of vertebrates: (1) somatic motor from the ventral horn cells, supplying the striated body musculature; (2) somatic sensory (general cutaneous), terminating in the dorsal horn and supplying the skin of the body; (3) visceral motor; (4) visceral sensory. The last two components are supposed to be related to the "intermediate zone," or lateral horn region of the spinal cord, the sensory fibers coming in by the dorsal roots and the motor fibers going out by both roots.

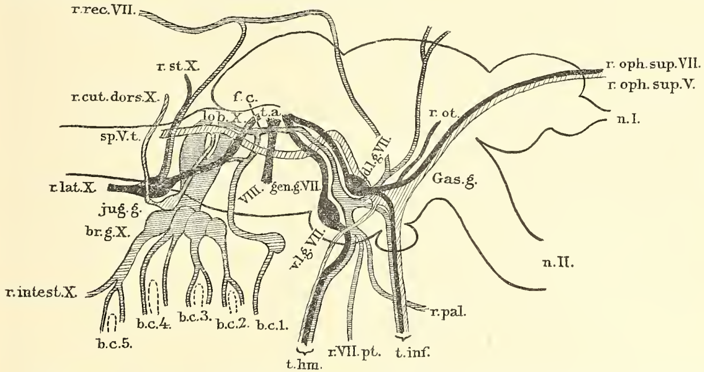
In *Menidia* the r. medius (r. lateralis of authors) of the several spinal nerves usually anastomoses with a twig of the r. lateralis vagi. The two nerves can, however, be distinguished after the anastomosis by the difference in the size of the fibers, and it is seen that the spinal nerve never participates in the innervation of the lateral line organs, but always goes to the skin adjacent. The anastomosis has no

* The technique employed here and in numerous other experiments with the Weigert processes carried on in connection with this work has been fully reported in a previous paper—"Report upon a Series of Experiments with the Weigert Methods," State Hospitals Bulletin, vol. II, Nos. 3 and 4, Utica, N. Y., 1897; also a full abstract of the above in Jour. Comparative Neurology, vol. VIII, Nos. 1 and 2, July, 1898.

morphological significance. The first spinal is obviously a fusion of two segmental nerves, possibly of more than two.

The cranial nerves.—The four components found in the trunk are also found in the head, though in some cases strangely modified; and in addition to these there is a fifth, the acustico-lateral component, which is not represented in any spinal nerve. There is no cranial nerve which contains all of these components, not even of the original four, and there is an obvious tendency toward the concentration of the fibers of each component so as to form a single system with a common center in the medulla oblongata, this being more marked in the case of the most highly specialized components and less so in those which are more feebly developed.

Of the motor systems, the somatic motor is represented only by the eye-muscle nerves and the hypoglossus. Undifferentiated viscero-motor fibers of uncertain connections probably go out with the vagus. The motor roots of the X, IX, VII, and V nerves probably represent highly specialized viscero-motor nerves developed in connection with the elaborate striated visceral musculature of the branchial arches and their derivatives. They appear to correspond to the viscero-motor fibers contained in the dorsal roots of the spinal nerves.



Description of figure.—A diagrammatic view of the sensory components of the cranial nerves of *Menidia*, as seen from the right side. The diagram is based upon a projection of the cranial nerves upon the sagittal plane made by reconstruction from serial sections. The general cutaneous component is indicated by the wide cross-hatching, the communis component by narrow cross-hatching and the acustico-lateral is drawn in black. The following explains the reference letters:

b. c. 1 to b. c. 5. The five branchial clefts.
b. r. g. X. The ganglia of the four branchial rami of the vagus, the last one containing also the ganglion of the r. intestinalis.
d. l. g. VII. The dorsal lateral line ganglion of the VII nerve.
f. c. Fasciculus communis.
Gas. g. Gasserian ganglion.
gen. g. VII. Geniculate ganglion of the VII nerve.
jug. g. The general cutaneous ganglion of the vagus nerve—jugular ganglion of Shore and Strong.
lob. X. The lobus vagi.
n. I. The olfactory nerve.
n. II. The optic nerve.
r. cut. dors. X. Ramus cutaneous dorsalis of the vagus.
r. intest. X. Ramus intestinalis of the vagus.
r. lat. X. Ramus lateralis of the vagus.
r. oph. sup. V. Ramus ophthalmicus superficialis trigemini.
r. oph. sup. VII. Ramus ophthalmicus superficialis facialis.
r. ot. Ramus oticus.
r. pal. Ramus palatinus facialis.
r. rec. VII. Ramus lateralis accessorius, or r. recurrens facialis.
r. st. X. Ramus supratemporalis vagi.
r. VII pt. Ramus pretrematicus facialis.
sp. V. t. Spinal V tract ("ascending root of the trigeminus").
t. a. The tuberculum acusticum.
t. hm. Truncus hyomandibularis of the facial nerve.
t. inf. Infraorbital trunk, containing the r. mandibularis V, the r. maxillaris V, and the r. buccalis VII, together with communis fibers.
VIII. The eighth nerve.
v. l. g. VII. The ventral lateral-line ganglion of the VII nerve.

The relations of the sensory nerves in the head of *Menidia* are exhibited in the preceding diagram. The somatic sensory or *general cutaneous nerves* of the head all terminate in the sp. V tract, which is the continuation into the head of the dorsal horn of the spinal cord and which is represented in human anatomy by the "ascending root" and the chief sensory nucleus of the fifth nerve. This system receives a small root from the vagus nerve and all of its other fibers from the trigeminus, comprising the whole of the sensory portion of the latter nerve. The general cutaneous component appears at first sight to have been reduced in the head as compared with the trunk. Such, however, is not the case; it has merely been compacted. On the other hand, the skin of the face is certainly more richly supplied with general cutaneous (tactile) nerves than areas of corresponding size on the trunk.

The *communis system* of the head corresponds, in my judgment, with the viscero-sensory system of the trunk. Under this term I include all nerves which supply the mucous lining of the mouth and pharynx, sensory fibers of the r. visceralis vagi, and those for taste buds and their allies, the terminal buds of the outer skin. In *Menidia* all of these nerve fibers terminate in a single center, the lobus vagi, which corresponds to the sensory nucleus of the vagus in man. In some other bony fishes there is, in addition, a similar pre-auditory center, the so-called lobus trigemini (which is not, however, homologous with the "lobus trigemini" of ganoids and selachians). These communis fibers enter by way of the X, IX, and VII nerves, and are not represented in any other cranial nerve roots. Like the general cutaneous nerves, they have been unified into a very compact system with a single center. This system has been enormously hypertrophied in the head, and for a double purpose. In the first place, the viscero-sensory nerves of the trunk seem to have been in large measure supplanted by the r. intestinalis vagi. In the second place, the cephalic end of the digestive tract requires a proportionally greater nerve supply for its elaborate branchial and labial apparatus. And, in connection with the latter, more highly specialized sense organs (taste buds) have been developed in response to an obvious functional need. The advantage to be derived from such a centralization of the sensory apparatus of the entire digestive tract is obvious. In *Menidia* the fibers of this system enter the lobus vagi either directly by the vagus or through the mediation of the fasciculus communis from the IX and VII nerves.

The *acustico-lateral system* has no direct representative in any spinal nerve. To it belong all the nerves which supply the lateral line organs and the organs of the internal ear. These nerves all terminate together in the tuberculum acusticum, and the auditory nerve is the only survivor of this system in the higher vertebrates. What may be the relationship between this system and the other, probably phylogenetically older, sensory systems is as yet problematical; it has probably been derived from the general cutaneous.

It is obvious that in making comparisons between cranial and spinal nerves more attention should be paid to the morphological differences between these several types of nerve fibers than has hitherto been done by most morphologists and embryologists. There is to-day as little justification for the direct homologizing of general cutaneous nerves of the trunk with, say, the nerves supplying taste buds in the head as there would be for the comparison of a motor with a sensory root; and yet it is not infrequent to see dorsal spinal roots compared with all dorsal cranial roots indiscriminately.

The following paragraphs give the components of the several cranial nerves as I have found them in *Menidia*, together with a few items concerning their distribution.

XII nerve.—This nerve is represented in the first member of the first spinal complex. It supplies the post-hyal ventral somatic musculature. The pre-hyal somatic musculature is not present in the teleosts, the so-called m. genio-hyoideus not being homologous with the muscle of that name in the other vertebrates.

XI nerve.—The spinal accessory nerve can be positively identified, going out with the vagus and innervating the trapezius muscle. It probably arises from the nucleus ambiguus and is viscero-motor in nature.

X nerve.—This nerve contains viscero-motor, viscero-sensory (communis), general cutaneous and lateral line fibers. The two first types make up most of the nerve. The general cutaneous component is small, but has its own ganglion and enters the rami cutanei dorsales. The large root of the lateral line nerve of the trunk is conventionally assigned to the vagus, though it is really distinct.

IX nerve.—The glossopharyngeus contains only viscero-motor and communis fibers. A small bundle of the latter passes by intra-cranial anastomosis into the root of the n. lateralis vagi. These fibers pass out with the first three or four branches of the n. lateralis (the first of these being the n. supra-temporalis vagi), accompanying the proper lateralis fibers, and ultimately they anastomose with the r. lateralis accessorius. The IX nerve in *Menidia* lacks the r. pre-trematicus and the r. supra-temporalis.

VIII nerve.—This nerve supplies the usual organs of the internal ear and belongs exclusively to the acustico-lateral system.

VII nerve.—The facial nerve contains viscero-motor, communis, and lateralis fibers. The communis fibers form the whole of the pre-auditory fasciculus communis, are provided with a special ganglion, the geniculate g., and are distributed to nearly all of the rami of the V + VII complex, as follows: (1) To the r. palatinus (comprising the whole of that nerve), for the mucosa and taste buds of the roof of the mouth; (2) to the truncus hyomandibularis VII, for the mucosa and taste buds of the inside of the lower jaw and lip; (3) to the r. maxillaris V, to taste buds within the upper lip; (4) fibers passing dorsally into the cranial cavity, forming in the meninges an elaborate plexus, and finally combining to form the facial root of the r. lateralis accessorius (r. recurrens VII), which runs the length of the body superficially near the median line. (5) Other communis fibers supply some terminal buds on the top of the head and run forward with the r. ophthalmicus superficialis. (6) In addition to the preceding, there is a small twig which leaves the geniculate ganglion between the truncus hyomandibularis and the r. palatinus, running directly ventrally to the roof of the mouth, supplying its mucosa in the region between the areas supplied by the IX and palatine nerves. It passes along the cephalic face of the very large pseudobranch and also innervates this organ. This nerve represents, apparently, the pre-trematic branch of the facial, the truncus hyomandibularis being the post-trematic. The pseudobranch of this fish, then, represents a vestigeal spiracular gill on the mandible, such as we find a rudiment of in the adult *Torpedo*.

The acustico-lateralis component of the VII nerve is represented by two lateral line roots. (*a*) The ventral lateralis root has a separate ganglion and supplies organs of the opercular and mandibular canals, via the truncus hyomandibularis. (*b*) The dorsal lateralis root also has a separate ganglion and supplies organs of the infra-

orbital and supra-orbital lines, via the r. buccalis and r. ophthalmicus superficialis VII, respectively.

VI nerve.—A somatic motor nerve.

V nerve.—The trigeminus contains viscero-motor and general cutaneous components. The sensory fibers enter the spinal V tract, with which is doubtless associated the chief sensory nucleus of the V nerve. The Gasserian ganglion is clearly separable from the other ganglia of the V + VII complex, though most of the earlier writers on fish nerves have treated the whole collection together as the Gasserian. Cutaneous fibers go out from it to the r. ophthalmicus superficialis V (which is fused with the nerve of the same name from the seventh nerve), the r. maxillaris V, the r. mandibularis V, the truncus hyomandibularis VII for the operculum, and, finally, the r. ophthalmicus profundus V. The latter nerve consists of a few fibers which accompany the sympathetic radix longa of the ciliary ganglion to that ganglion, beyond which they can no longer be separately followed. The relations of this nerve, which has not been reported by previous students of the teleosts, indicates that the embryonic profundus ganglion has fused with the Gasserian.

The motor fifth supplies the muscles usually described for teleosts, and in addition the so-called m. genio-hyoideus. The innervation of this muscle has hitherto been usually assumed to come in teleosts from the VII nerve. This muscle is almost certainly not homologous with the muscle in the corresponding position of other vertebrates, which is innervated by the first spinal or hypoglossus nerve.

The IV and III nerves are purely somatic motor, while the II and I nerves can not as yet be placed in any of these categories.

This investigation, which is still incomplete, has been carried out partly at Columbia University, partly at the Pathological Institute of the New York State Hospitals, and during the summer of 1898 at the laboratory of the United States Fish Commission at Woods Hole, Mass. Several morphological points which remain obscure can be finally cleared up only by the embryological method. Accordingly, during the present season I have secured and raised the eggs of *Menidia*, putting up series of the embryos with a view to some studies in the organogeny in the near future.

The eggs of our two common species (which I have elsewhere described) are very similar. Those of the larger species, *Menidia notata*, after artificial fertilization, can be easily reared in ordinary hatching jars, and I obtained stages up to 6 days after hatching (16 days after fertilization) and later stages by towing in the harbor at Woods Hole. But the eggs of the smaller species, *Menidia gracilis*, which inhabits the tide pools and protected bays, I was never able to hatch, though the eggs seemed normal and fertile and the conditions were the same as for the other species. The eggs would grow for from 6 to 12 hours and would then gradually die out. Possibly these fishes normally spawn in brackish water.

I am under very special obligation to the United States Fish Commission, which has freely furnished all things needful for this work, and particularly to the director of its laboratory for many unusual courtesies.

GRANVILLE, OHIO, *August 1, 1898.*

Contributions from the Biological Laboratory of the U. S. Fish Commission, Woods Hole, Massachusetts.

THE REAPPEARANCE OF THE TILEFISH.

By HERMON C. BUMPUS, Ph. D.,
Director of Biological Laboratory of United States Fish Commission.

During the past summer the investigations of the United States Fish Commission have brought to light the facts that the tilefish (*Lopholatilus chamæleonticeps*), once supposed to be extinct, occurs in great numbers off the southern coast of New England, and that its capture requires only the ordinary apparatus used in cod and haddock fishing. This fish possesses excellent food qualities and its reappearance may result in the development of an industry of considerable importance. Its history is of scientific interest, since it furnishes evidence that life on the sea bottom is subject to periodic modification, and that a species almost annihilated may become quickly reestablished.

In May, 1879, Captain Kirby, of Gloucester, in command of the schooner *William V. Hutchins*, while searching for cod and hake almost directly south of Nantucket, caught great numbers of a "strange and handsomely colored fish." The first catch, of nearly 2,000 pounds, was made in water varying from 80 to 120 fathoms in depth, at latitude 40° 04′ N., longitude 70° 23′ W. Four trawls were used, each about a mile in length, and bearing 1,000 hooks. Nearly all of these fish were thrown overboard, but a few were kept and cooked.

Captain Kirby stated that they were the finest fish he had ever eaten, and he determined to save and salt all that he might catch. The trawls were set the same day in latitude 40° 04′ N., longitude 70° 17′ W., and again in latitude 40° 00′ N., longitude 70° 04′ W. Both sets yielded about 2,000 pounds of dressed fish, which, on being landed in Gloucester, were sold to Messrs. Friend & Son, who disposed of them in various ways.

Captain Kirby sent one of the fish to the United States National Museum, where it was examined by Messrs. Goode & Bean, and described (Proceedings U. S. Nat. Mus., vol. II, pp. 205–208) as a new genus and species (*Lopholatilus chamæleonticeps*). Recently it has been assigned by Jordan & Evermann to the family *Malacanthidæ*, a group of fishes of somewhat obscure relationship, found in temperate and tropical seas.

In July of the same year Captain Dempsey, also of Gloucester, caught 9 tilefish while fishing for cod in a locality 50 miles south by east of No Man's Land, in 75 fathoms of water.

Professor Baird took great interest in the discovery of this new fish. Its fine flavor and attractive appearance indicated excellent marketable qualities, and its great abundance promised to be a profitable source of income to offshore fishermen.

The *Fish Hawk* took 3 specimens on the 13th of September, 1880, in 126 fathoms, latitude 39° 57′ N., longitude 70° 56′ W., and so anxious was Professor Baird to gain additional information that he chartered the fishing smack *Mary Potter*, of Noank, in which Mr. Vinal Edwards left Newport for the tilefish grounds on the 29th of September. A trawl line of 400 hooks, baited with menhaden, was set in 127 fathoms, but only a swordfish and two skates were caught. Threatening weather then drove the vessel back to port.

On August 9, 1881, trawl lines were set from the *Fish Hawk* in 134 fathoms, latitude 40° 02′ N., longitude 71° 12′ W., and 8 tilefish, weighing 147 pounds, were taken. On August 23, in latitude 40° 03′ N., longitude 70° 31′ W., 73 fish, weighing 540 pounds, were taken. The trawl line was set again on September 21 at a point farther to the eastward, latitude 39° 58′ N., longitude 70° 06′ W., in water of 113 fathoms, but no fish were taken.

In March and April, 1882, vessels entering New York and other Atlantic ports reported that they had passed through countless numbers of dead fish while crossing the northern edge of the Gulf Stream. Investigation proved that these were tilefish, and that they appeared on the surface of the water over an area of 170 miles in length and 25 miles in width. A conservative estimate, made by Capt. J. W. Collins (Fish Commission Report for 1882), who has given a detailed history of the tilefish up to the time of this mortality, placed their number at upwards of 1,438,720,000. Allowing 10 pounds to each fish, he has estimated that there would be 288 pounds of fish for every man, woman, and child in the United States.

In September, 1882, Professor Baird chartered the *Josie Reeves*, and sent her to the tilefish grounds, that he might ascertain to what extent the species had been depleted, but the vessel returned without having found a single individual. This seemingly unprecedented destruction of marine life was extensively commented upon both by newspapers and scientific journals, and in the Report of the U. S. National Museum for 1889 the tilefish was placed, provisionally, in a list of extinct animals.

The scientific work that finally led to the rediscovery of the animal really began in the summer of 1880, when the completion and equipment of the *Fish Hawk* made it possible to enter upon lines of investigation which before were out of the question. This vessel has added materially to the practical efficiency of the Commission, and its frequent employment by men of science has greatly increased our knowledge of oceanic life.

In November, 1880, Professor Verrill published his memorable "Notice of the remarkable marine fauna occupying the outer banks of the southern coast of New England" (Am. Jour. Sci., Nov. 1880, p. 390), in which he gave the scientific results of three excursions made by the *Fish Hawk*. On these excursions the dredge was used 23 times, and an enormous number of deep-sea animals were taken. Among these were 130 species of mollusks, 26 echinoderms, 43 crustacea, and 16 fish new to the southern coast of New England, and many of these animals were also new to science.

During the following summer, 1881, seven excursions were made to the Gulf Stream, where, besides the work done with the line trawl already mentioned, the

dredge was used 47 times. It is fortunate that these investigations were made in 1880 and 1881, since they furnished definite data respecting the physical and biological conditions of a tract of the sea bottom which in the spring of 1882 became the scene of widespread devastation.

While Captain Collins was collecting his data, the *Fish Hawk*, which had taken a few tilefish in 1880, and had found them very numerous in 1881, was continuing her deep-sea explorations under the direction of Professor Verrill. During August, September, and October, 1882, five trips were made to the tilefish grounds, and the dredge was lowered 46 times. The definite information relative to the life on the sea bottom, which Professor Verrill had been able to secure during the summers of 1880 and 1881, now became of great value, since it enabled him to report on the general faunistic changes which had affected this area, to measure the extent of the destruction of oceanic life, and to give an intelligent reason therefor.

In the report for 1882, he writes:

> One of the most peculiar facts connected with our dredging this season (1882) was the scarcity or absence of many of the species, especially crustacea, that were taken in the two previous years, in essentially the same localities and depths, in vast numbers, several thousand at a time.

In another article (Physical characters of the portion of the continental border beneath the Gulf Stream, explored by the *Fish Hawk*, 1880 to 1882), Professor Verrill describes the rapid incline of the sea bottom beyond the 100-fathom line, "usually as steep as the side of a great mountain chain, and about as high as Mount Washington, New Hampshire." He further writes:

> The bottom along the upper part of this slope and the outermost portion of the adjacent plateau, in 65 to 150 fathoms, and sometimes to 200 fathoms or more, is bathed by the waters of the Gulf Stream. Consequently the temperature of the bottom water along this belt is decidedly higher than it is along the shallower part of the plateau near the shore, in 25 to 60 fathoms. * * * We may therefore call the upper part of the slope, in about 85 to 150 fathoms, the "warm belt."—(Report U. S. Fish Commission for 1882, p. 279.)

It was along this warm belt that many animals characteristic of tropical or subtropical fauna were dredged in 1880 and 1881, and Professor Verrill states:

> In fact, this belt is occupied by a northern continuation of the southern or West Indian Gulf-Stream fauna * * * that could not exist there if the Gulf Stream did not flow along this area at the bottom, both in winter and summer.

The tilefish, whose relatives are known to be tropical, doubtless belongs to this warm-water fauna, and the destruction of 1882 was explained by Professor Verrill when he wrote, in October of that year:

> It is probable, therefore, that the finding of vast numbers of dead tilefish floating at the surface in this region last winter was connected with a wholesale destruction of the life at the bottom, along the shallower part of this belt (in 70 to 150 fathoms), where the southern forms of life and higher temperature (47° to 52°) are found. This great destruction of life was probably caused by a very severe storm that occurred in the region at that time, which, by agitating the bottom water, forced outward the very cold water that even in summer occupies the wide area of shallower sea in less than 60 fathoms along the coast, and thus caused a sudden lowering of the temperature along this narrow warm zone, where the tilefish and the crustacea referred to were formerly found.
>
> The warm belt is here narrow, even in summer, and is not only bordered on its inner edge, but is also underlaid in deeper water by much colder water. In fact, the bottom water inshore is probably below 32° F. in winter where the depth is 20 to 40 fathoms. In August this year (1882) we found the temperature 37° F., south of Cape Cod, in 55 to 60 fathoms. It is evident, therefore, that even a moderate agitation and mixing up of the warm and cold water might in winter reduce the temperature so much as to practically obliterate the warm belt at the bottom. But a severe storm, such as the one

referred to, might even cause such a variation in the position and direction of the tidal and other currents as to cause a direct flow of the cold inshore waters to temporarily occupy the warm area, pushing farther outward toward the Gulf-Stream water. The result would in either case be a sudden and great reduction of temperature, perhaps as much as 15° to 20°. This could not fail to be very destructive to such southern species as find here nearly their extreme northern limits. It is probable, however, that these southern species, including the tilefish, were not thus destroyed farther south. Therefore it is probable that in a few years they will again occupy these grounds by migrating northward, even if there be not enough left here to replenish their races.—(Report of the United States Fish Commission, 1882, p. 279.)

These quotations are here inserted because they are based on facts ascertained by those interested in the scientific work of the Commission and because they explain adequately the cause of the mortality, ascribing it to climatic changes.*

In 1883 the *Fish Hawk* made but one excursion to the Gulf Stream, and even then did not reach the edge of the "warm belt," the deepest water in which the dredge was cast being only 62 fathoms. The *Albatross* worked on the ground, however, and cast the dredge at least 20 times over the area known to have been occupied previously by the tilefish. Since 1883, up to the present time (January, 1899), the *Fish Hawk* has not again attempted to explore this portion of the sea bottom.

In 1884 the *Albatross* made a most careful survey of the "tilefish grounds" and the tracts of deeper and shallower water bounding the same. The dredge was lowered 76 times, and although material of great scientific interest was secured, no trace of the tilefish was found.

In 1885 the examination of the sea bottom in this locality was continued, and the dredge was lowered from the *Albatross* 38 times.

In 1886 the *Albatross* lowered the dredge 14 times, but no tilefish were found.

It is worthy of note that the first cruise made by the Fish Commission schooner *Grampus* was to the tilefish grounds. The vessel left Newport on August 14, 1886, and set trawls in 96 fathoms (latitude 39° 59′ N., longitude 70° 15′ W.), and although trawls and hand lines were repeatedly used until August 21 the ground was so barren that only a few hake were taken. The stomachs of these fish showed a scarcity of food suitable for the *Lopholatilus*, and Captain Collins concluded that—

It is safe to say that the large number of sets made with the trawl line on this occasion, together with the trials made with hand lines, clearly demonstrate the fact that if the tilefish has not become absolutely extinct in this region it is certainly so rare that the chances of obtaining it are limited.

In 1887 the *Albatross* made three unsuccessful efforts to find the tilefish, and in November left the Atlantic waters and sailed to the Pacific, where she has remained.

In 1888 no attempt was made to visit the tilefish ground.

In 1889 Prof. William Libbey, jr., began a series of temperature and specific gravity observations off the shore of southern New England, which extended directly over this interesting tract. These observations were made for the purpose of "establishing some connection between the changes in temperature in the waters and the migrations of the fish which inhabit them." The *Grampus* was placed at the disposal of Professor Libbey, and an account of his work for the summer of 1889 will be found

*Professor Libbey, in a paper read before the Geographical Congress in 1895, claims that the effect of any single storm is largely superficial, and that it takes the resultant of several years of storms permanently in one direction or the other to produce such effects in deep water. Professor Libbey ascribes the disappearance of the fish to conditions just the reverse of those mentioned by Professor Verrill, namely, the cold body of water on the continental platform was allowed to advance over the area upon the edge of the continental plateau by a retrogression of the warm waters of the Gulf Stream produced by the exact opposite of the conditions which caused its advance toward the same edge.

in the U. S. Fish Commission Bulletin, vol. IX. This account contains a record of over 1,600 temperature observations, and the general results were of such importance that Commissioner McDonald continued the work during the summer of 1890, at which time the United States Coast Survey steamer *Blake* was detailed to act in cooperation with the *Grampus*.

During the summer of 1891 the *Grampus* was placed again at the disposal of Professor Libbey, and the work was continued along the same lines as during the two previous years. Unfortunately, the results of these investigations, perhaps the most complete ever conducted over a tract of the ocean of equal extent, have never been published, although they yielded extremely important data relative to the physical changes affecting the sea and the sea bottom. Professor Libbey found that a comparison of the temperature records as shown by the temperature cross-sections constructed upon the basis of the observations made in this body of water for the three years 1889, 1890, and 1891, demonstrated that there had been a progressive movement of the warm water, of 50° temperature, toward the shore.

In a communication addressed to Commissioner McDonald in 1892, Professor Libbey wrote:

> In 1889 the lower portion of the curve did not touch the edge of the continental platform at any point within the area we were studying. In 1890 this portion of the curve touched the continental edge both at Block Island and off Nantucket Island in the latter part of the season; and in 1891, as has been said, it touched along the whole edge of this portion of the platform during the greater part of the summer. The change which was thus produced in the temperature at the bottom along this edge of the continental platform was in the neighborhood of 10°, an item of considerable importance.—(Report U. S. Fish Commission, 1893, p. 34.)

Professor Libbey, in a conference with Commissioner McDonald, showed that if the movement of the warm band toward the shore continued during the summer of 1892, the whole of the continental edge, or that part of it upon which the tilefish had once flourished, would present environmental conditions favorable to the return of the fish. The importance of these presentations was recognized by Commissioner McDonald, and though other work had been laid out for the *Grampus*, she was ordered to prepare for further explorations of the Gulf Stream and the bottom fauna off the southern New England coast. Professor Libbey writes:

> In July the Commissioner and myself went out in the schooner *Grampus*, south of Martha's Vineyard, to the area which seemed to promise a reward for our labors. We found the temperature conditions right, set the cod trawls, and caught the tilefish. During the remaining portion of the summer I spent considerable time tracing out the limits of the area over which the temperature of 50° and above could be found, using the trawl lines at the same time to ascertain if the fish were there. We found them all the way to the Delaware capes, and were satisfied that, though they were not numerous, they had taken advantage of the changed conditions to occupy the area.

It is thus seen that whereas Professor Verrill in 1882 had given reasons for the disappearance of the fish, and had stated that, "It is probable that in a few years they will occupy these grounds by migrating northward, even if there be not enough left here to replenish their race," and although an indiscriminate search of ten years had failed to find any trace of the lost fish, the results of Professor Libbey's temperature investigations enabled him to show that the physical conditions of the sea bottom were variable, to prove that there was a definite movement of warm water toward the area earlier occupied by the tilefish, and to predict that if this movement continued the tilefish would be found again in its old habitat.

Eight specimens of tilefish were taken by the *Grampus* in 1892, as indicated in the following table:

Date.	Station No.	Depth.	Lat. N.	Long. W.	No. of tilefish.	Weight.
Trip 1:		*Fms.*	° ′ ″	° ′ ″		*Lbs.*
Aug. 5, 1892	1	75	40 04 00	70 27 00	....	....
Aug. 5, 1892	2	70	40 01 00	70 35 00	....	....
Aug. 6, 1892	3	98	40 02 00	70 38 00	....	....
Aug. 6, 1892	4	74	40 06 30	71 00 00	1	7
Aug. 6, 1892	5	76	40 05 00	71 04 00	....	....
Trip 2:						
Aug. 11, 1892	6	84	40 06 00	71 00 00	....	....
Aug. 13, 1892	7	108	39 57 00	71 32 00	....	....
Aug. 13, 1892	8	91	40 01 00	71 25 00	....	....
Trip 3:						
Aug. 18, 1892	9	78	40 08 00	71 08 00	1	13
Aug. 18, 1892	10	82	40 00 00	71 24 00	....	....
Aug. 19, 1892	11	51	40 05 00	71 23 00	....	....
Aug. 20, 1892	12	78	40 02 00	71 28 00	....	....
Trip 4:						
Sept. 7, 1892	13	84	39 36 00	71 46 30	....	....
Sept. 9, 1892	14	79	39 44 30	71 58 00	....	....
Sept. 10, 1892	15	90	39 34 00	72 06 00	....	....
Sept. 10, 1892	16	58	39 38 00	72 16 00	....	....
Trip 5:						
Sept. 17, 1892	17	58	39 40 00	72 34 30	....	....
Sept. 17, 1892	18	65	39 30 00	72 28 00	....	....
Sept. 17, 1892	19	74	39 26 00	72 22 30	1	(?)
Sept. 18, 1892	20	75	39 20 00	72 27 30	3	(?)
Sept. 18, 1892	21	95	39 28 00	72 11 00	....	....
Trip 6:						
Oct. 3, 1892	22	72	38 09 00	73 55 00	....	....
Oct. 7, 1892	23	67	38 25 00	73 36 00	....	....
Oct. 8, 1892	24	70	38 40 00	72 58 00	2	(?)
Oct. 8, 1892	25	85	38 52 00	72 58 00	....	....
Oct. 9, 1892	26	100	39 07 00	72 45 00	....	....

Two of the stations (4 and 9) at which tilefish were taken are located on the original tilefish ground, at a point that had not been tested by either the *Fish Hawk* or the *Albatross*, although the latter vessel in 1883 dredged within 7 miles of this spot, and in 1886 Captain Collins used trawls still nearer. The other stations at which the fish were found (19, 20, and 24) were considerably farther to the west, a locality that had been examined by the *Albatross* in 1883 and again in 1884. This locality, near the great submarine channel which cuts through the continental shelf from the mouth of the Hudson to the deep water underlying the Gulf Stream, was the seat of continued investigations during the following season.*

The reasons for the movements of the *Grampus* in 1892 and 1893 are stated in a communieation from Professor Libbey, bearing date April 3, 1899, in reply to certain qnestions which I had asked.

"With regard to the capture of the tilefish (in 1892), to the westward of the positions where my observations had been made, I would say that the faets which have been published eover only a small amount of the items which are to be derived from a careful and systematic study of the temperature observations. When in Washington, at the time of the conferenee with Colonel McDonald, I told him that if the tilefish were of a tropical form he might expect to find the fish that year, provided the conditions I anticipated were fulfilled at one of two points, and I marked the positions on a map in his office—one of them being off the Delaware capes, the other south of Martha's Vineyard—and I gave as my reasons that I felt quite sure that the break or depression in the continental edge, representing the bed of the Hudson River, was of such a character and depth as to prevent the tilefish from crossing it, unless the high temperature had proceeded far enough inland, or in toward the land, to make a connection across the upper part of this depression. If you will examine the charts of the Coast Survey you will find that there is a somewhat remarkable depression on the edge of the continental platform to the southeast of the month of the Hudson River. It was my idea that a band of warm waters moving in from the southeast would touch this platform; but as the tilefish apparently was a bottom fish, the migration of the school would stop if the temperature variations did not touch the bottom clear around this depression. If such were the case, the fish would be found off the Delaware capes only; but if the connection had been made the fish would probably be found in both places. * * * * * *

"When we succeeded in finding the fish in the area where my observations had been made, I immediately suggested to Colonel McDonald that we follow up the edge of the continental platform,

In 1893 the *Grampus* made five trips in search of the tilefish, set the trawls at 18 stations, and caught 53 fish. Although the trawls were set at 5 places near stations 4 and 9, no fish were taken, so that the greater amount of time was spent near the "Hudson Channel," where on one occasion a single set of the trawl yielded 24 fish.

The record for 1893 is as follows:

Date.	Station No.	Depth.	Lat. N.			Long. W.			No. of tilefish.	Weight.
		Fms.	°	′	″	°	′	″		*Lbs.*
Trip 1:										
July 19, 1893	27	93	39	58	00	71	19	00		
July 20, 1893	28	75	39	15	00	72	31	30		
July 20, 1893	29	86	39	14	00	72	29	00		
July 21, 1893	30	78	39	23	00	72	24	00	1	4
July 21, 1893	31	74	39	23	00	72	25	00	2	
July 21, 1893	32	71	39	22	00	72	24	30	1	
Trip 2:										
July 25, 1893	33	70	39	25	00	72	27	00	1	
July 27, 1893	34	74	39	20	00	72	28	00		
July 27, 1893	35	69	39	25	00	72	19	00	*4	
Trip 3:										
Aug. 10, 1893	36	79	39	19	30	72	25	30	1	
Aug. 11, 1893	37	73	39	20	00	72	28	45	†24	
Trip 4:										
Aug. 19, 1893	38	72	39	23	00	72	32	00	6	
Aug. 20, 1893	39	72	39	23	00	72	29	00	7	
Aug. 22, 1893	40	75	39	18	21	72	23	00	6	
Aug. 22, 1893	41	64	39	19	00	72	34	30		
Trip 5:										
Sept. 21, 1893	42	68	40	04	00	71	25	00		
Sept. 21, 1893	43	78	40	07	30	71	14	00		
Sept. 22, 1893	44	65	40	12	00	71	10	00		
Sept. 22, 1893	45	80	40	14	30	71	01	00		

*Ovaries of fish fully developed. † Spawn in advanced stage.

During 1894, 1895, and 1896 the *Grampus* and *Fish Hawk* were engaged with other work, and it was the general opinion that, although scattered specimens of the tilefish might be found, they were not sufficiently abundant to warrant continued efforts toward their capture.

On February 8, 1897, the 78-ton schooner *Mabel Kenniston* was overtaken by a gale while on the Georges Bank, and was blown to the westward about 120 miles. The exact location is not definitely known, but it was about 140 miles southwest of No Man's Land, in latitude about 39° 40′ N. and longitude 72° 10′ W. Haddock trawls

to the westward, as far as the season and the finances of the Commission would permit, in order to verify the facts and see whether the conditions of the theory which I had advanced really seemed to hold good along the southwestern projection of the continental platform. As this conference took place on the *Grampus* and no instructions aside from the verbal understanding between us are in existence, the mere fact that such work was done at that time and under my direction can hardly be explained in any other way.

"With reference to the other question, that in 1893 no tilefish were found near the seventy-first meridian, while a large number were taken near 72° 30″ W., 39° 20″ N., this would tend, in my opinion, to confirm this statement, because the location which you have given would seem to show that, if not a permanent break in this Hudson River depression, at least a temporary break had occurred. Some fish must have gone across this break, because we found the proper temperatures and proper conditions all around the sides of this depression in 1892. The warm water may have withdrawn slightly, so as to interrupt the movement of the school of fish along the bottom after that time.

"The answers to your questions all hang together upon the establishment of that one point, and here I think I have temperature observations enough to warrant me in the statement that while we did find the tilefish over the whole area in 1892, it is quite probable that the general conditions had not become permanent along the edge of the continental platform, but that they were still undergoing a species of oscillation. It is my impression that if we have a series of years, in the near future, with a predominance of northwesterly winds, we will be treated sooner or later to a new disappearance or annihilation of that same body of fish, because you will easily see that if the warm band representing the lower layers of the Gulf Stream is ever withdrawn from the continental edge, it will probably be withdrawn in the manner in which I have indicated, and then the conditions for the disappearance of the fish will be at hand once more."

set in 65 fathoms of water, when brought to the surface, yielded a catch of 30 tilefish, weighing from 6 to 15 pounds apiece. These were landed in Gloucester on February 16, where they were distributed, and those who ate them stated that they were "better than salmon." The captain of the *Mabel Kenniston* thought the catch of tilefish would have been considerably larger had it not been that the dogfish were very abundant and troublesome.

In August, 1898, the *Grampus* was placed at the disposal of the Director of the Biological Laboratory of the United States Fish Commission at Woods Hole, and a small party of naturalists, quite ignorant of the catch that had been made by the *Mabel Kenniston* in 1897, boarded the vessel on August 12, for the purpose of examining the surface fauna in the warmer waters of the Gulf Stream, and to make a trial for the tilefish, although the apparatus for the latter work was crude and unsatisfactory. At noon on the 13th of August a trawl was set in 70 fathoms of water in latitude 40° 11′ N. and longitude 70° 48′ W. After it had been on the bottom not more than an hour, it was drawn, and 8 tilefish were taken; fully a third of the hooks had been torn away from the rotten gangings. The capture of these 8 tilefish was a most welcome surprise to those on board of the boat, because the trawl that had been used was in a miserable condition, and baited with squeteague, which are unsuited for this method of fishing. Moreover, the line rested on the bottom but a comparatively short time. The boat was immediately headed for Woods Hole to obtain the necessary equipment for a more careful survey of the tilefish grounds.

The locality that had been thus examined was about 10 miles to the eastward of the position occupied by the *Grampus* in 1892, where McDonald and Libbey had caught the first fishes since the mortality of 1882. It was, however, a spot that had not been examined by the vessels that had searched for the tilefish during the intervening years.

Commissioner George M. Bowers very willingly provided the necessary apparatus for a more thorough examination of the tilefish ground, and on the 30th of August the *Grampus* left Woods Hole, sailed to Newport, where two barrels of small mackerel were taken on board for bait, and early on the morning of August 31 two trawls were set in 75 fathoms of water in latitude 40° 08′ N., longitude 71° 12′ W. This was a point about 20 miles to the westward of the location at which the fish were found on August 13, but when the trawl was drawn and the dory had returned to the boat, 7 beautiful tilefish were thrown on to the deck of the *Grampus*. With these were two large skates, two squid, and a small hake. Two trawls, each 200 fathoms in length, were used, and each trawl was provided with 300 hooks. The tilefish were all caught on hooks that had been baited with mackerel. The skates were taken on hooks that had been baited with squeteague.

The boat then ran a few miles to the eastward and the trawls, again baited with mackerel, were set in 75 fathoms. After remaining out for a few hours they were hauled, and from the deck of the *Grampus* we could see the sailors tugging at the line and rolling the great fish over into the boat. When the dory came alongside, the men threw 47 beautiful tilefish on the deck. This was the greatest catch since the mortality of 1882, and proved conclusively that the animal was reestablished in its former habitat.

There was time before dark for the trawls to be set again, although they could remain out but a short time; 19 additional fish, however, were taken, making a total of 73 for the entire day. Although many were young fish weighing less than 2 pounds,

several were over 20 pounds in weight. The presence of large numbers of young fish is of considerable biological importance, for it indicates that the fish are breeding, and that those now found on the old tilefish ground are not there as a result of migration.

On the following day, September 1, three sets were made, yielding 78 fish, and as the bait was now exhausted, the *Grampus* headed for Montauk Point for the purpose of distributing her fare to the soldiers at Camp Wickoff.

After returning from Camp Wickoff, the *Grampus* was delayed at Woods Hole until the latter part of the month. On September 28 Captain Hahn set sail for the edge of the Gulf Stream, with instructions to find, if possible, the eastern limit of distribution of the tilefish. On September 29 he set two tubs of trawl in latitude 40° 01′ N., longitude 69° 54′ W., in 77 fathoms. The trawls were allowed to remain out $2\frac{1}{2}$ hours, and when hauled 61 tilefish, 1 dogfish, 12 skate, and 3 eels were taken. At 10 a. m. on the same day the lines were set some 8 miles to the eastward, and, after 3 hours, 59 tilefish, 100 dogfish, and 2 skate were captured. At 3 p. m. 3 tubs of trawl were set about 5 miles farther to the eastward, in 72 fathoms of water, and remained out for $2\frac{1}{2}$ hours. While this set was being drawn into the dory unfortunately the line parted, and presumably half the fish were lost. It was dark and the outer buoy could not be located. The fragment of line contained 38 tilefish, and nearly every hook not occupied by a tilefish had caught a dogfish; indeed, the great number and weight of the dogfish accounted for the parting and loss of the line.

On the morning of September 30 a trawl was set in 76 fathoms, latitude 40° 03′ N., longitude 69° 16′ W. It was out 3 hours, and when drawn into the dory 19 tilefish, 2 skate, and 4 hake were taken. At this time only $1\frac{1}{2}$ tubs of trawl were used, about 550 hooks. Still farther to the east, at station 12, only 14 tilefish were taken, and, at the easternmost station, 40° 05′ N., 69° 06′ W., only 12 tilefish were caught, $1\frac{1}{2}$ tubs of trawl line being used.

It would appear from these figures that Captain Hahn had found the eastern boundary of the tilefish "bank," near the sixty-ninth meridian, although even at his last trial several large fish were taken.

This was the last excursion for tilefish made in 1898, and it may be safe to conclude that, inasmuch as on every occasion that the trawl was set in water of appropriate depth the tilefish were found, their area of distribution probably extends from 69° to 73° west longitude, and along a band of the sea bottom of varying width, and from 70 to 80 fathoms in depth, although no tests were made in deeper water.

A tabulated statement of the localities which were examined follows:

Date.	Station No.	Depth.	Lat. N.			Long. W.			No. of tilefish.	Weight.
		Fms.	°	′	″	°	′	″		*Lbs.*
Trip 1:										
Aug. 13, 1898...	1	75	40	11	00	71	48	00	8	....
Trip 2:										
Aug. 31, 1898...	2	75	40	08	00	71	12	45	7	....
Aug. 31, 1898...	3	75	40	12	00	71	05	00	47	350?
Aug. 31, 1898...	4	75	40	11	15	71	03	45	19	74
Sept. 1, 1898...	5	80	40	14	15	71	00	15	24	80?
Sept. 1, 1898...	6	....	40	15	30	70	55	45	39	825?
Sept. 1, 1898...	7	....	40	16	00	70	54	30	15	138
Trip 3:										
Sept. 29, 1898...	8	77	40	01	00	69	54	30	61	658
Sept. 29, 1898...	9	71	40	04	00	69	45	30	59	825
Sept. 29, 1898...	10	72	40	04	00	69	39	00	38	422
Sept. 30, 1898...	11	76	40	03	00	69	16	00	19	214
Sept. 30, 1898...	12	70	40	04	30	69	11	00	14	96
Sept. 30, 1898...	13	75	40	05	30	69	06	00	12	120
Oct. 1, 1898...	14	60	40	10	00	69	50	00	....	....

Measurements of weight and length of fish caught during the excursions of 1898 are recorded here, since they may form a basis for estimating the rate of growth during succeeding years:

Weight and length of tilefish taken in 1898.

Date.	Station No.	Fish No.	Length.	Weight.	Date.	Station No.	Fish No.	Length.	Weight.
			Inches.	*Pounds.*				*Inches.*	*Pounds.*
Aug. 13	1	1			Aug. 31	4	12	22.50	3.75
Aug. 13	1	2			Aug. 31	4	13	23.50	5
Aug. 13	1	3			Aug. 31	4	14	24	4.50
Aug. 13	1	4			Aug. 31	4	15	24.50	6
Aug. 13	1	5			Aug. 31	4	16	25.50	5.50
Aug. 13	1	6			Aug. 31	4	17	29	10.50
Aug. 13	1	7			Aug. 31	4	18	31	12
Aug. 13	1	8			Aug. 31	4	19	33	14
Aug. 31	2	1	12.75		Sept. 1	5	1	13	.50
Aug. 31	2	2	13		Sept. 1	5	2	13	.50
Aug. 31	2	3	13.25		Sept. 1	5	3	13.50	.50
Aug. 31	2	4	13.75		Sept. 1	5	4	13.50	.50
Aug. 31	2	5	14		Sept. 1	5	5	13.50	.50
Aug. 31	2	6	14		Sept. 1	5	6	13.75	.50
Aug. 31	2	7	15.75		Sept. 1	5	7	13.75	.50
Aug. 31	3	1	17	1.50	Sept. 1	5	8	14	.50
Aug. 31	3	2	17	1.50	Sept. 1	5	9	14	.50
Aug. 31	3	3	17.25	1.75	Sept. 1	5	10	14	.50
Aug. 31	3	4	17.25	1.75	Sept. 1	5	11	14	.50
Aug. 31	3	5	17.50	1.75	Sept. 1	5	12	14	.50
Aug. 31	3	6	17.50	1.50	Sept. 1	5	13	14.50	.75
Aug. 31	3	7	17.50	1.75	Sept. 1	5	14	17.25	1.75
Aug. 31	3	8	17.50	1.50	Sept. 1	5	15	17.50	1.75
Aug. 31	3	9	18	2	Sept. 1	5	16	17.50	1.75
Aug. 31	3	10	18	2	Sept. 1	5	17	17.75	1.375
Aug. 31	3	11	18	2	Sept. 1	5	18	18	1.75
Aug. 31	3	12	18	2	Sept. 1	5	19	18.75	2
Aug. 31	3	13	18	1.75	Sept. 1	5	20	20.75	3.50
Aug. 31	3	14	18	1.50	Sept. 1	5	21	23.75	5.50
Aug. 31	3	15	18	1.75	Sept. 1	5	22	29	11.50
Aug. 31	3	16	18	2	Sept. 1	5	23	29.50	12
Aug. 31	3	17	18.25	2	Sept. 1	5	24	33.50	20
Aug. 31	3	18	22.50	5	Sept. 1	6	1	17	1.50
Aug. 31	3	19	23	5	Sept. 1	6	2	18	1.75
Aug. 31	3	20	23	4.75	Sept. 1	6	3	18	1.75
Aug. 31	3	21	23	5	Sept. 1	6	4	18.25	2
Aug. 31	3	22	23	5	Sept. 1	6	5	18.75	2
Aug. 31	3	23	23	5	Sept. 1	6	6	19	2
Aug. 31	3	24	23	4.50	Sept. 1	6	7	20.75	3
Aug. 31	3	25	23.25	4.50	Sept. 1	6	8	21	2.50
Aug. 31	3	26	23.50	5	Sept. 1	6	9	22.75	5
Aug. 31	3	27	23.50	4.75	Sept. 1	6	10	22.75	5
Aug. 31	3	28	24	5	Sept. 1	6	11	23.25	5.50
Aug. 31	3	29	24	5.50	Sept. 1	6	12	23.50	6.50
Aug. 31	3	30	24	5.50	Sept. 1	6	13	23.50	4.75
Aug. 31	3	31	25	7.50	Sept. 1	6	14	24	5.50
Aug. 31	3	32	25	7	Sept. 1	6	15	24	6
Aug. 31	3	33	26		Sept. 1	6	16	24.50	5.50
Aug. 31	3	34	26	7.50	Sept. 1	6	17	24.75	6.50
Aug. 31	3	35	26	7	Sept. 1	6	18	25	8
Aug. 31	3	36	26	8	Sept. 1	6	19	25	6.25
Aug. 31	3	37	28	9.50	Sept. 1	6	20	25	7
Aug. 31	3	38	28	10	Sept. 1	6	21	26	8
Aug. 31	3	39	29	19	Sept. 1	6	22	26	8
Aug. 31	3	40	33	21.50	Sept. 1	6	23	26.50	6.50
Aug. 31	3	41	34	20	Sept. 1	6	24	26.50	8
Aug. 31	3	42	34	19.50	Sept. 1	6	25	26.50	9
Aug. 31	3	43	34	19.50	Sept. 1	6	26	26.50	9
Aug. 31	3	44	34	19	Sept. 1	6	27	28	10
Aug. 31	3	45	34	18	Sept. 1	6	28	28.75	10.50
Aug. 31	3	46	34.50	22	Sept. 1	6	29	29	11
Aug. 31	3	47	34.50	20	Sept. 1	6	30	29	11
Aug. 31	4	1	13.50	.50	Sept. 1	6	31	29.25	11
Aug. 31	4	2	15	.50	Sept. 1	6	32	29.75	12
Aug. 31	4	3	16	.50	Sept. 1	6	33	33	6
Aug. 31	4	4	17.50	1.75	Sept. 1	6	34	33	20
Aug. 31	4	5	18	1.50	Sept. 1	6	35	34	22.50
Aug. 31	4	6	18.50	1.75	Sept. 1	6	36	34	22
Aug. 31	4	7	19	2	Sept. 1	6	37	34	21
Aug. 31	4	8	19	1.375	Sept. 1	6	38	34.50	21
Aug. 31	4	9	19	1.75	Sept. 1	6	39	35	22
Aug. 31	4	10	19.50	1.75	Sept. 1	7	1	17	1.50
Aug. 31	4	11	19.50	1.25	Sept. 1	7	2	17.50	1.75

Weight and length of tilefish taken in 1898—Continued.

Date.	Station No.	Fish No.	Length.	Weight.	Date.	Station No.	Fish No.	Length.	Weight.
			Inches.	*Pounds.*				*Inches.*	*Pounds.*
Sept. 1	7	3	22	4.75	Sept. 29	9	9	26	9
Sept. 1	7	4	22.50	4.50	Sept. 29	9	10	26	11
Sept. 1	7	5	24	6	Sept. 29	9	11	26	10
Sept. 1	7	6	24	5	Sept. 29	9	12	26	9
Sept. 1	7	7	24.50	6.50	Sept. 29	9	13	26	9
Sept. 1	7	8	24.50	7	Sept. 29	9	14	27	10
Sept. 1	7	9	25	7.50	Sept. 29	9	15	27	11
Sept. 1	7	10	25	6	Sept. 29	9	16	27	10
Sept. 1	7	11	28	9.75	Sept. 29	9	17	27	10
Sept. 1	7	12	28.50	10.50	Sept. 29	9	18	27	9
Sept. 1	7	13	31.50	15	Sept. 29	9	19	27	9
Sept. 1	7	14	33	19	Sept. 29	9	20	27	12
Sept. 1	7	15	33.50	20	Sept. 29	9	21	27	9
Sept. 29	8	1	13	1	Sept. 29	9	22	27	11
Sept. 29	8	2	13	1	Sept. 29	9	23	27	11
Sept. 29	8	3	13	1	Sept. 29	9	24	27	10
Sept. 29	8	4	14	9	Sept. 29	9	25	27	9
Sept. 29	8	5	14	1	Sept. 29	9	26	28	11
Sept. 29	8	6	17	24	Sept. 29	9	27	28	12
Sept. 29	8	7	17	2	Sept. 29	9	28	28	10
Sept. 29	8	8	17	2	Sept. 29	9	29	28	10
Sept. 29	8	9	17	2	Sept. 29	9	30	29	9
Sept. 29	8	10	18	2	Sept. 29	9	31	29	10
Sept. 29	8	11	20	9	Sept. 29	9	32	29	9
Sept. 29	8	12	21	3	Sept. 29	9	33	29	10
Sept. 29	8	13	22	5	Sept. 29	9	34	30	12
Sept. 29	8	14	23	1	Sept. 29	9	35	30	9
Sept. 29	8	15	24	27	Sept. 29	9	36	30	12
Sept. 29	8	16	24	10	Sept. 29	9	37	30	10
Sept. 29	8	17	24	8	Sept. 29	9	38	30	12
Sept. 29	8	18	25	7	Sept. 29	9	39	30	11
Sept. 29	8	19	26	10	Sept. 29	9	40	30	10
Sept. 29	8	20	26	8	Sept. 29	9	41	30	11
Sept. 29	8	21	26	10	Sept. 29	9	42	31	10
Sept. 29	8	22	26	9	Sept. 29	9	43	31	23
Sept. 29	8	23	26	11	Sept. 29	9	44	31	11
Sept. 29	8	24	26	9	Sept. 29	9	45	33	20
Sept. 29	8	25	26	6	Sept. 29	9	46	33	20
Sept. 29	8	26	26	11	Sept. 29	9	47	33	22
Sept. 29	8	27	26	10	Sept. 29	9	48	35	21
Sept. 29	8	28	26	10	Sept. 29	9	49	35	22
Sept. 29	8	29	27	5	Sept. 29	9	50	36	21
Sept. 29	8	30	27	11	Sept. 29	9	51	36	23
Sept. 29	8	31	27	7	Sept. 29	9	52	36	24
Sept. 29	8	32	27	20	Sept. 29	9	53	36	27
Sept. 29	8	33	27	16	Sept. 29	9	54	36	22
Sept. 29	8	34	27	10	Sept. 29	9	55	36	26
Sept. 29	8	35	27	11	Sept. 29	9	56	38	24
Sept. 29	8	36	27	9	Sept. 29	9	57	38	27
Sept. 29	8	37	27	11	Sept. 29	9	58	39	29
Sept. 29	8	38	28	12	Sept. 29	9	59	40	26
Sept. 29	8	39	28	10	Sept. 29	10	1	15	1
Sept. 29	8	40	28	2	Sept. 29	10	2	16	1
Sept. 29	8	41	28	11	Sept. 29	10	3	19	3
Sept. 29	8	42	28	13	Sept. 29	10	4	20	2
Sept. 29	8	43	28	13	Sept. 29	10	5	21	8
Sept. 29	8	44	28	13	Sept. 29	10	6	23	6
Sept. 29	8	45	29	11	Sept. 29	10	7	23	6
Sept. 29	8	46	30	10	Sept. 29	10	8	24	10
Sept. 29	8	47	30	15	Sept. 29	10	9	24	10
Sept. 29	8	48	30	16	Sept. 29	10	10	25	8
Sept. 29	8	49	30	15	Sept. 29	10	11	26	9
Sept. 29	8	50	31	4	Sept. 29	10	12	26	11
Sept. 29	8	51	31	15	Sept. 29	10	13	27	9
Sept. 29	8	52	32	19	Sept. 29	10	14	27	9
Sept. 29	8	53	32	21	Sept. 29	10	15	27	10
Sept. 29	8	54	33	18	Sept. 29	10	16	27	10
Sept. 29	8	55	33	9	Sept. 29	10	17	27	9
Sept. 29	8	56	33	10	Sept. 29	10	18	27	10
Sept. 29	8	57	33	25	Sept. 29	10	19	27	10
Sept. 29	8	58	34	15	Sept. 29	10	20	27	11
Sept. 29	8	59	35	26	Sept. 29	10	21	27	9
Sept. 29	8	60	35	24	Sept. 29	10	22	27	10
Sept. 29	8	61	36	22	Sept. 29	10	23	28	10
Sept. 29	9	1	10	26	Sept. 29	10	24	28	11
Sept. 29	9	2	24	9	Sept. 29	10	25	28	11
Sept. 29	9	3	24	9	Sept. 29	10	26	29	11
Sept. 29	9	4	25	9	Sept. 29	10	27	29	12
Sept. 29	9	5	25	9	Sept. 29	10	28	29	13
Sept. 29	9	6	26	10	Sept. 29	10	29	30	14
Sept. 29	9	7	26	9	Sept. 29	10	30	30	14
Sept. 29	9	8	26	9	Sept. 29	10	31	31	15

Weight and length of tilefish taken in 1898—Continued.

Date.	Station No.	Fish No.	Length.	Weight.	Date.	Station No.	Fish No.	Length.	Weight.
			Inches.	*Pounds.*				*Inches.*	*Pounds.*
Sept. 29	10	32	31	16	Sept. 30	12	1	15	2
Sept. 29	10	33	33	16	Sept. 30	12	2	18	2
Sept. 29	10	34	33	19	Sept. 30	12	3	18	2
Sept. 29	10	35	34	19	Sept. 30	12	4	18	2
Sept. 29	10	36	34	24	Sept. 30	12	5	18	2
Sept. 29	10	37	35	22	Sept. 30	12	6	21	5
Sept. 29	10	38	36	23	Sept. 30	12	7	25	7
Sept. 30	11	1	16	2	Sept. 30	12	8	26	12
Sept. 30	11	2	18	2	Sept. 30	12	9	26	9
Sept. 30	11	3	24	12	Sept. 30	12	10	27	9
Sept. 30	11	4	24	6	Sept. 30	12	11	28	10
Sept. 30	11	5	27	10	Sept. 30	12	12	28	10
Sept. 30	11	6	27	11	Sept. 30	12	13	29	11
Sept. 30	11	7	27	9	Sept. 30	12	14	30	13
Sept. 30	11	8	27	9	Sept. 30	13	1	13	1
Sept. 30	11	9	27	8	Sept. 30	13	2	14	1
Sept. 30	11	10	27	9	Sept. 30	13	3	16	2
Sept. 30	11	11	27	10	Sept. 30	13	4	18	2
Sept. 30	11	12	27	12	Sept. 30	13	5	27	10
Sept. 30	11	13	27	11	Sept. 30	13	6	27	11
Sept. 30	11	14	28	10	Sept. 30	13	7	29	12
Sept. 30	11	15	29	11	Sept. 30	13	8	29	13
Sept. 30	11	16	30	13	Sept. 30	13	9	30	13
Sept. 30	11	17	36	26	Sept. 30	13	10	30	13
Sept. 30	11	18	36	19	Sept. 30	13	11	30	15
Sept. 30	11	19	36	24	Sept. 30	13	12	36	27

Following are abstracts of some recent letters concerning the food qualities of the tilefish:

[From Mr. H. R. Storer, Providence, R. I.]

The tilefish was boiled for dinner, and what was left therefrom warmed with cream for breakfast the next morning. Both dishes proved delicious, even more so than cod, which is my favorite. I sent a portion of the fish to my neighbor, Mr. Benj. R. Smith, and his family gave an equally satisfactory report.

[From Mr. W. P. Titcomb, Washington, D. C.]

Regarding the sample of the tilefish with which you favored me last week, I have to say that I rate it as equal in texture and flavor to any salt-water fish, except the mackerel, which of course will not bear transportation and retain its flavor as the tilefish evidently does. Although very fond of halibut, and rating it very highly, I am inclined to think from this, the only sample of tilefish which I have tasted, that I should regard it as equally desirable.

[From Mr. Lucian D. Sharpe, II, Providence, R. I.]

I wish to acknowledge the fine tilefish you were kind enough to send us. We enjoyed it very much, and the flesh was quite fine and sweet, though with not as much flavor as some fish have.

[From Mr. Nathan Babcock, Westerly, R. I.]

Through the kindness of Mr. J. A. Ripple I had a sample of the "tile," the rediscovered fish. I think it is an excellent fish. It far surpasses the cod. It is delicate in flavor, and in all respects very palatable. It will find favor with those who enjoy good fish.

[From Mr. J. M. K. Southwick, Newport, R. I.]

I promised you a report on the tilefish. Briggs thinks it rather dry and tasteless. H. Christian thought it very good. Charles Clark baked his and liked it very much. J. I. Wright boiled his and says it was excellent; knew no fish he liked better; thought it very good, better than cod. Edw. Lilley thought it very nice. Capt. J. V. Cotton says it was between a cod and a halibut. The writer boiled his and remarked the same lack of taste noted by Briggs, but juicy, not dry. I consider it a very valuable edible fish.

[From Mr. John F. Calkins, Providence, R. I.]

Tilefish is good. Boiled, first class; broiled, fair; made into a salad, excellent. I think that with proper preparation it would be good baked. Of course, like all fish, the fresher the better. I see no reason why it should not become a valuable addition to our list of food-fishes. It should not be boiled one moment beyond the point of "done." I noted plenty of gelatine in it.

[From Messrs. Johnson & Smith, Boston, Mass.]

Yours in regard to the tilefish received, asking our opinion of it. We found it to be a good fish for eating, having a fine flavor, resembling that of our striped bass or what they call in Washington rockfish. It has also lasting qualities, remaining in good condition for several days, which is greatly in its favor. We hope that we may soon have more of it.

[From Hon. Eugene G. Blackford, New York, N. Y.]

In reply to your favor of the 20th, permit me to say that I consider the tile an excellent table fish. The flesh is somewhat coarse, but very sweet, and I should say that it more nearly resembles the blackfish or tautog than any other fish I can recall. I should recommend to those testing its edible qualities to have it baked and served with a brown sauce.

Out of the fish that you sent as an experiment to this market I selected some for a dinner at the Union Club of this city—the most prominent of all our clubs. The fish was served to about twenty-five gentlemen, nearly all of whom might be considered gastronomical experts, and they were all delighted with it. I may say parenthetically that the fish were at least a week old when they were served, so that I question whether the best possible results were obtained from the test of their edible qualities.

THE

PRESERVATION OF FISHERY PRODUCTS FOR FOOD.

By CHARLES H. STEVENSON.

SYNOPSIS.

SOUTH SIDE OF T WHARF, THE WHOLESALE FRESH-FISH CENTER OF BOSTON.

THE PRESERVATION OF FISHERY PRODUCTS FOR FOOD.

By Charles H. Stevenson

INTRODUCTION.

Methods of preservation are of constantly increasing importance to the prosperity of the fisheries—more so, perhaps, than to any other food-supplying industry. In agriculture, cereals are cured sufficiently in the open air to keep for indefinite periods; vegetables and fruits with proper care will generally remain in edible condition long enough to reach distant markets, and some will last until the following season; the domestic animals intended for food may be transported alive to the place of marketing and there slaughtered; but, under ordinary conditions, fishery products are subject to rapid putrefaction after removal from the water.

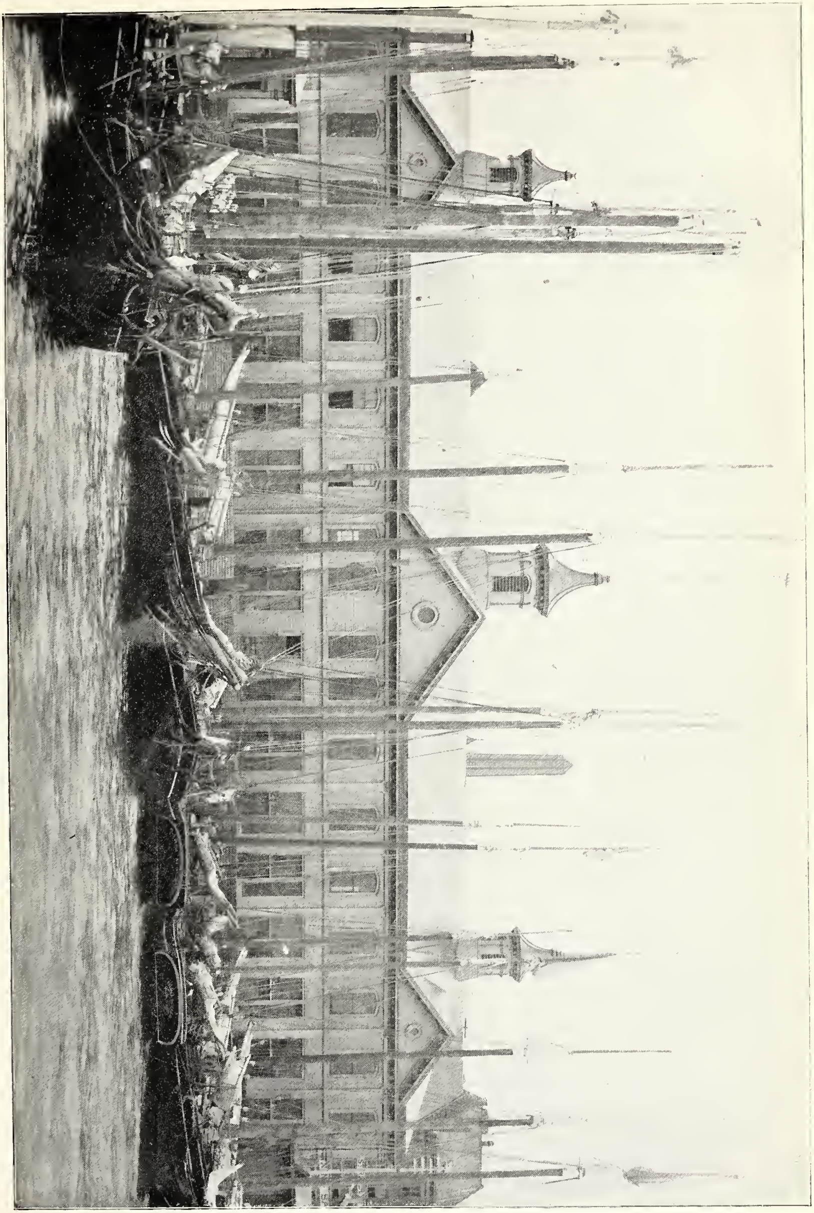
It is now a generally accepted opinion that all putrefaction is caused by the development of living organisms known generally as bacteria or putrefactive germs, this theory being announced first in 1837 by the German physiologist, Theodore Schwann. "Putrefaction," says Cohn, "begins as soon as bacteria, even in the smallest numbers, are introduced, and progresses in direct proportion to their multiplication." In living animals there is a tendency to counteract the development of these germs, and maintaining marine animals alive is the simplest form of preservation, although rarely the most economical. After life is extinct, heat, moisture, and air are all more or less necessary to the development of bacteria, and it is principally by removing one or all of these factors that preservation is accomplished. This gives us three principal methods of preserving dead fish, viz: Refrigeration, which diminishes the heat; desiccation or drying, which decreases the moisture; and canning, which separates the preserved product from the air. Another method of great importance is the application of antiseptics, such as salt, vinegar, etc., this process being known generally as pickling. Other forms of preservation, the most important of which is smoking, partake of the characteristics of the preceding with the addition of further treatment for the purpose of flavoring. These six processes, viz, preserving alive, refrigeration, desiccation, canning, pickling, and smoking, include practically all the general methods of preserving fishery foods.

The qualities of the original products, however, are so varied and subject to such delicate influences that a process well adapted to the preservation of one article may be impracticable or deleterious when applied to another, even of the same class. Thus it would not do to refrigerate salmon, herring, and oysters in the same manner; nor is the process of salting codfish, halibut, herring, and swordfish the same. The manner of preservation also differs according to the market for which the article is intended. Codfish destined for the New England market would not be suitable for the Gulf States, and that for the West Indies and Brazilian trades requires still different

treatment. Therefore, in this report the general method of each form of preservation is first noted, and then its particular process of application to each species and for each of the principal markets is described. It should be remembered, however, that the excellence of any particular product does not arise wholly from the special mode of preservation, but from care and attention in the process, guided by experience and close observation. No matter what process is employed, careful treatment during all the various stages is of fundamental importance, and without it no first-class article will be produced. A serious difficulty with which the fishery trade has to contend is the competition with products of careless or indifferent preservation. In too many cases superior quality of the product is sacrificed entirely to cheapness of production, and preparers who desire to maintain a high standard suffer from the resulting competition and frequently are compelled to cheapen their own process or retire from the business.

In few countries has greater attention been given to the preparation of fishery food products than in the United States. In the various international expositions our exhibits of this class have excited favorable comment because of the great variety and excellence of the products and the neat and convenient forms in which they are prepared for sale. The large representation of foreign nationalities in the United States has probably been a factor in increasing the number of our methods of preparing marine foods. People immigrating to America and devoting their time to handling fishery products naturally make use of the ideas and methods in vogue in their native countries. The smoking of haddock and some other species was introduced in this way by Scotchmen; the Chinese on the Pacific coast and in Louisiana prepare fish, shrimp, etc., by methods similar to those practiced in the Orient, and the preparation of sturgeon products was first begun here by natives of Germany and adjacent countries. The congregation of people of foreign birth in our coast cities also tends to increase the list of fishery products; a small local sale for certain articles developing among those people, the trade gradually extends until such articles become of recognized importance in the food markets. There are, however, many additional methods of preserving marine food products that could be employed advantageously to meet the wants of new markets. Numerous products highly valued in Europe and Asia are never utilized here, although abundant in the United States waters; and a large part of our fishery resources are undeveloped through a failure to appreciate and follow the foreign methods of preservation. Herring, for instance, is one of the most abundant species of fish on the United States coast, being very frequently obtainable in much larger quantities than the fishermen make use of, yet the United States imports annually over $2,000,000 worth of herring products.

The purpose of this paper is not to instruct the various fishery preparators in the methods of their particular trade, but rather to present the chief processes employed, and thus enable those who are interested to compare the different methods. The author has carefully consulted the fishery literature and has freely availed himself of the data contained therein, yet he has avoided giving a description without actual knowledge of the present processes or inquiry from persons familiar therewith. But no care or labor can wholly avoid mistakes, and as the plan of this work embraces a great variety of subjects concerning which much difference of opinion and practice exists among fishermen and marketmen it is altogether likely that it will be somewhat open to criticism, but it is hoped that the errors will not be so numerous or so gross as to materially impair its utility.



WATER FRONT OF FULTON FISH MARKET, THE WHOLESALE FRESH-FISH CENTER OF NEW YORK CITY.

PRESERVING FISHERY PRODUCTS ALIVE.

In some foreign countries, especially in Germany, a large portion of the fresh-water fish and some salt-water species are supplied to the markets alive. The live-fish trade in China is very extensive, the fish being peddled about the cities and villages in buckets of water, and those not sold are returned to inclosures of water for future sale. In the United States, however, live fish represent an inconsiderable portion of the trade. A few of the New York market fishermen take their catch of cod, sea bass, and blackfish into port alive by means of well-smacks, and some of the shore fishermen at points along the coast or on the interior waters retain their fish for a few days in live-cars or live-boxes; but the quantity of fish sold alive in this country is indeed very small. However, lobsters, crabs, oysters, clams, terrapin, and turtles are sold alive, and unless in that condition are not generally considered marketable as fresh, except in the case of shucked oysters and clams.

When practicable, this is one of the most satisfactory methods of marketing marine foods, not only because of the superior quality of the product, but also because it avoids costly processes of preservation. There is no general or uniform process employed for keeping the animals, each species receiving such treatment as it particularly requires. Fish and lobsters are kept alive in large inclosures or in well-smacks and live-boxes, while oysters, clams, terrapin, and turtles ordinarily require little care, unless they are to be held a considerable length of time.

INCLOSED WATER AREAS.

When whitefish were abundant in Lake St. Clair and Detroit River, a practice prevailed of building inclosures one-eighth to one-half acre or more in extent, conforming to the shore, for retaining the fish during October and November for sale during the early winter. These pens were usually built of 2-inch by 6-inch hard-wood piles driven into the bottom and projecting above the surface, with about $\frac{3}{4}$-inch space between the piles to allow the water to freely pass through the area. A platform with a barred entrance was arranged at one side to facilitate the handling of the seine and the admission of the fish into the pen, or this was accomplished by having a gate hinged to a mudsill at the bottom and with the upper part about a foot above the surface of the water and inclined at an angle of about 45°. The gate was opened by pushing it beneath the surface, when the fish might be easily emptied from the seine into the pond. The ponds were usually emptied before the end of December, the fish being removed from the inclosure as the market demand required. The introduction of freezing and the increasing scarcity of whitefish in Lake St. Clair led to the abandonment of these ponds about 1888. Whitefish are still preserved alive in net inclosures in Lake Erie, but this is principally for the purpose of obtaining eggs for use in artificial propagation.

At Port Huron, in 1881, Messrs. Früchtnicht & Neilson, of Sandusky, Ohio, constructed a large pen for retaining sturgeon alive. This inclosure covered an area

of about one-fourth acre, and was made by driving 2-inch by 12-inch hard-wood timbers into the ground about 2 inches apart on three sides of the pen, the beach forming the fourth side. The cost approximated $5,000. At one time the pen contained as many as 6,500 sturgeon. The fish were usually not fed at all, even though retained four or five months, and little depreciation occurred either in weight or quality. Feeding them on corn was attempted, but they did not appear to require it. The sturgeon were caught for removal by means of a short seine having a chain on the bottom. They had a tendency to burrow, and it was sometimes difficult to catch one even when there were a hundred or more in the pen. The business was highly successful until the decreasing supply of these fish caused its abandonment about 1887.

At several other points on the Great Lakes there were inclosures for retaining sturgeon, and at some of them a regular practice prevailed of feeding the fish on corn. In the fisheries of North and South Carolina it was formerly customary to provide pens in which sturgeon were confined until a sufficient number had been accumulated for a "killing." Some fishermen whose operations were less extensive, however, did not resort to building a pen, but would merely pass a rope through the lower jaw of each fish and fasten the other end to some convenient fixture.

The trap fishermen of Rhode Island have large pounds, made of twine, and sometimes 60 feet square and 30 feet deep, in which scup and other fish are held for two or three months. Sometimes 12,000 barrels of fish are there held for a month or two. The trap fishermen of other localities sometimes have a similar contrivance on the back of each trap net, in which a few barrels of fish may be held for several weeks.

Quantities of striped bass and perch were formerly kept alive for a week or more in southern Delaware by inclosing them in pens built of pine logs along the river banks.

On the coast of Maine there are several inclosed coves or ponds for confining lobsters several months, if necessary, the principal ones being at Vinal Haven, Southport, House Island, South Pond, Prospect Harbor, and Friendship. Their form and adaptability depend on the coastal formation. The first one was established at Vinal Haven, in Penobscot Bay, in 1875, by Messrs. Johnson & Young, of Boston, and that is yet the largest and most successful on the coast. It is the small end of a cove covering about 500 acres, communicating with the sea through a 150-foot channel, in which the tidal range is about 10 feet and the depth from 30 to 180 feet, averaging about 90 feet. The inclosure devoted to lobsters covers about 9 acres, and is separated from the large cove by a natural shoal surmounted by a stout wire fence about 200 feet long. Its bottom is of soft grayish mud and the water ranges from 10 to 60 feet in depth. It has a capacity for about 300,000 lobsters, but a smaller quantity usually does better. The capacity of the other ponds or coves ranges from 25,000 to 200,000 lobsters.

The lobsters are deposited in the inclosures when the condition of the market warrants and are held for a higher price. They are fed quite regularly on cheap fresh fish of various kinds, principally split hake, hake heads, small cod, herring, flounders, bream, etc. Fat herring are not desirable for lobster food, as practical experience has shown that they cause the lobsters to decrease in weight. For the same reason, when using hake, it is well to remove the livers, as they are rather too oily. The quantity of food required depends largely on the temperature of the water, since lobsters do not eat as freely in cold water as in that of a higher temperature. The food should be well scattered over the pond, as throwing it in heaps causes the lobsters to congregate

in large numbers, resulting in their biting and injuring each other in their contests for food. If not fed regularly it is quite difficult to keep the lobsters in the inclosure, but when properly supplied they seem contented and improve both in appearance and weight; yet it is not generally profitable to feed them for an increase in weight alone, the profit coming from the ability to place them on the market when the prices are the highest. In catching them seines, pots, or beam trawls are employed. The latter are usually 12 feet across, with 18-inch runners. If properly attended, the mortality is small and the lobsters improve in weight and condition. It is estimated that in November, 1898, there were 700,000 lobsters retained in the ponds or inclosures in Maine.

At several of the fishery ports along the Gulf of Mexico there are small inclosures for retaining green turtle and terrapin. These are usually 400 or 500 square feet in area, and are made by driving rough poles into the ground near the shore, where the water is 6 or 8 feet deep at low tide, connecting and bracing them by nailing a strip along the line near the top, the poles being 1 or 2 inches from each other and sufficiently long to project a few feet above the surface of the water. For convenience in handling the turtle these pens are generally constructed adjacent to the landing pier leading to a market house. The turtle are placed in the pen and removed therefrom by means of a block and tackle attached to a swinging arm. They are generally fed on algæ, fish, etc., until it is desirable to market them, when they are placed in boxes, barrels, or otherwise secured, and shipped without further care.

WELL-SMACKS.

Well-smacks were introduced in England in 1712, being first used at Harwich, where 12 were in operation as early as 1720, but the idea seems to have originated with the Dutch fishermen many years before. According to Dr. Fuller's "History of Berwick," well-smacks were used in carrying live salmon from Berwick to London prior to 1740, those vessels being of about 40 tons burden each.

Previous to the general use of ice on vessels, which began about 1840, most of the New England market vessels, especially those in the halibut fishery, were constructed with a well in the hold, in which the fish were retained alive until delivered at the fishing port. The use of well-smacks, or welled-smacks, in the halibut fishery began at New London, Conn., and Greenport, N. Y., about 1820, and by 1840 the fishery had extended to Georges Bank. Before the employment of these vessels the halibut fishery was prosecuted only during cold weather, the fish being carried in bulk in the hold.

The first well-smack at Gloucester was built in 1835 and was designed to carry about 12,000 pounds of halibut. The fish were caught by means of hand lines and were handled very carefully, being placed in the well immediately on removal from the water. Those dying before reaching market, through injuries or otherwise, were sold at about one-fourth the price of live halibut. On account of the greater convenience of using ice and the general adoption of trawl lines in the halibut fishery the well-smacks have been entirely superseded by tight-bottomed vessels.

Formerly nearly all fishing vessels running to the New York market during cold weather were constructed with wells. But the dwindling of the market cod fishery from that port, due to competition with Boston and other New England points having the benefit of the trade with drying establishments, has led to a large decrease in the

number of vessels engaged, and during recent years there have been only eight or ten vessels which during the winter and spring take their catch of cod, sea bass, and blackfish into Fulton Market alive. Well-smacks have been employed also in the red-snapper fisheries of Key West and Pensacola, but they are being discarded, it being found more satisfactory to ice the fish than to keep them alive. The lobster trade along the New England coast still uses a number of well-smacks, and in some of them steam has superseded the use of sails as a motive power.

The well in which the fish or lobsters are placed is situated amidships at the bottom of the hold, extending from just forward of the main hatch nearly to the mainmast, and occupying about one-third of the length of the vessel. It is formed by two stout, water-tight bulkheads at either end, 4 or 5 feet high and about 5 inches thick, extending from keelson to deck and entirely across the vessel. Midway between these is usually another bulkhead, which assists in supporting the deck and divides the well into two compartments. Leading from the well to the deck is a funnel curb, about 2½ feet wide by 8 feet long at its upper end and 4 feet long at its lower end. The well has neither keelson nor ceiling, and the frames are usually the same distance apart as elsewhere in the vessel, but on some smacks they are twice as far apart, in order to permit the water to circulate freely and to facilitate dipping the fish from the well. About 300 auger-holes are bored in the bottom planking of the well, through which the sea water freely enters, and it is kept in circulation and constantly renewed by the motion of the boat. On the lobster smacks the auger-holes are generally 2 inches in diameter, whereas those on fish smacks are more frequently 1 inch. The vessels range from 12 to 60 tons and those using sails are either schooner or sloop rigged, though more frequently of the former type.

On the British coast a number of "dry-well" smacks, having an artificial circulation of water, are employed. In some of these there is a series of one or more lengths of perforated supply pipes arranged near the bottom of the well and connected at one end to a circulating pump operated by the main engine if on a steamer, or by a donkey engine or otherwise if on a sailing vessel, a two-way cock being on the pipes outside the well. The pipes, being at the bottom of the well, cause a continual circulation of water in an upward direction and thoroughly aerate the water as well as cause all the scum and refuse to rise to the top, whence, along with the used water, it escapes back into the sea through several bell-mouthed overflow pipes, the lower ends of which pass through the vessel's bottom and are mounted so as to incline aft from the top, and thus allow the force from the forward movement of the vessel to suck them clear. The aeration of the water can thus be kept under perfect control and the well be readily emptied of water by pumping when it is desired to remove the fish.

The well-smacks running cod, sea bass, and tautog to the New York market, which fish off Sandy Hook and Long Island shore, have capacity for 8,000 to 20,000 pounds of fish each, depending on the time of the year and the length of the trip. Hand lines are employed for the most part and the fish are placed in the well as soon as taken from the water, the hook being carefully removed. Each vessel generally carries a small quantity of ice, with which to preserve such fish as may die, as well as the surplus that can not be placed in the well, this ice being carried in pens at either end of the well. The cod when caught in no great depth of water live in the well, under ordinary conditions, a week or more, but the sea bass and tautog are not

so hardy and do not keep much more than half that long. The length of time which the cod will live depends also on the time they have been kept on the trawls, in case that form of apparatus is used. On arrival at Fulton Market the fish are removed from the well with long-handled dip nets, and placed in wooden cars, which are kept floating in the dock. For a description of these cars see next page.

Lobster smacks are employed mainly along the coast of Maine and Massachusetts, but there are a few at New York, Greenport, and New London. Up to a few years ago vessels of this type were used in bringing lobsters from Nova Scotia, but at present those shipments are made usually in barrels on regular commercial steamers. The lobster smacks are mostly old vessels which were formerly employed in the live-fish trade before icing became the general practice; but many fine vessels are now coming into use, and at Portland, Maine, four steamers are engaged in this trade. About 60 well-smacks are now employed in transporting lobsters along the coast, running to Rockland, Portland, Boston, New London, New York, etc. Their capacity ranges from 3,000 to 16,000 lobsters, with an average of about 9,000 during cold weather and about two-thirds or half that number when the weather is warm. The loss in transit is small, rarely amounting to 2 per cent, unless the weather is calm or the loaded smack remains in still water very long, when the lobsters use up the air held in solution by the water and smother. These vessels are not so extensively employed as a few years ago, on account of the competition with steamer and railroad transportation, but they are yet an important factor in connection with the lobster trade.

The well-smacks until recently employed in the Gulf of Mexico red-snapper fishery were of the same type as those in use on the New England coast, indeed most of them were designed for the New England fisheries. At Key West a number of smaller sail craft, known locally as "smackees," are provided with wells. These boats average about 25 feet long, 8 feet wide, and 4 or 5 feet deep, with sharp bottom, the deep draft being necessary in order to submerge the hull sufficiently for the water to cover the fish in the well, which occupies about a quarter of the boat's length measured on the keel.

On account of the great depth from which red snappers and groupers are as a rule obtained, considerable difficulty was at first experienced in keeping them alive, the pressure of the water being so much less in the wells than at a depth of several fathoms that the air bladder would become greatly distended and the fish float belly up. To overcome this the fishermen adopted a practice of puncturing the air bladder as soon as the fish reaches the surface, forcing a hollow metal tube $\frac{1}{4}$-inch in diameter into the side of the fish a little behind and just above the pectoral fin, thus relieving the air bladder of its extreme buoyancy so that the fish may control its movements in the well. Only those red snappers taken in less than 10 fathoms of water can be successfully held in the wells for a week or two; if caught in more than 10 fathoms they must be handled carefully, and if from over 20 fathoms they soon have a swollen surface, the eyes protruding and the scales becoming loosened and standing erect. For the purpose of holding the surplus fish when the well became overcrowded, some of the smack fishermen also carried two or three cars, about 8 feet long, 4 feet deep, and 4 feet wide, so constructed that they could be taken apart and stowed below deck. But, as before stated, the use of ice has almost entirely superseded the employment of well-smacks in the red-snapper fishery.

LIVE-CARS OR LIVE-BOXES.

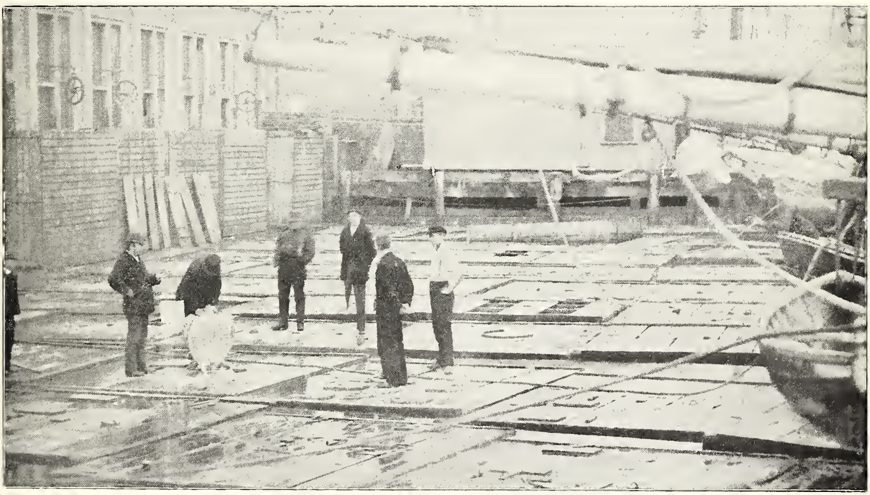
The most usual method of keeping fishery products in captivity alive is by means of live-cars or live-boxes. These are employed in the market fishery of New York, the lobster fishery of the New England States, the catfish fishery of Louisiana, the seine fishery of the Gulf of Mexico, and in numerous other small fisheries along the coast and on the interior waters. Ordinarily they are plain wooden boxes, with open seams or numerous auger-holes to permit a free circulation of water and yet not so large as to permit the escape of the fish, their size and shape conforming to the requirements of the fishes and the localities for which they are intended. The buoyancy of the material entering into their construction keeps them at the surface of the water, with little more than the upper portion exposed, this position being regulated if necessary by attaching floats or weights, as the case may require. When it is desirable to move them frequently from place to place they are made in the form of skiffs.

The live-cars employed at Fulton Market, New York City, for retaining cod, sea bass, and tautog or blackfish brought in by the well-smacks, are of various sizes, but generally about 18 feet long, 12 feet wide, and from 2 to 3 feet deep, the depth being greater in the center than at the two ends. They are made of planking 1 inch thick and 6 inches wide, nailed to a rectangular frame of joist, with spaces of 1 or 2 inches between the planks to allow free circulation of water, and are without partitions on the inside and without barrels or other buoys. In the top of each are two pairs of doors, running the entire length of the car, but covering only about half the width, and which may be fastened with a padlock. The cars are moored in the dock at the rear of the market, and by means of tackle attached to the rear of each fish-house they are raised occasionally and rested on a platform or float running the entire length of Fulton Market, so that they may be cleaned and dried to prevent their becoming water-logged. They cost about $24 each and have capacity for 3,000 or 4,000 pounds of fish under ordinary conditions. No food is given the fish confined in the cars and the length of time during which they may be kept depends on the weather. If bottom ice forms, the tautog may all die in one night, but the cod are quite hardy. As soon as the fish are removed from the cars they are killed, and being much fresher and firmer they are sold at a higher price than that received for fish brought in packed in ice. These cars are used also for holding lobsters and green turtle alive.

At certain of the European fishing ports the retaining of live cod in floating cars is quite extensive. From Holdsworth's "Sea Fisheries" is obtained the following account of the business at Grimsby:

When the smacks arrive with their cargoes of live and dead fish at Grimsby, the cod in the well are taken out by means of long-handled landing nets, and are placed in wooden boxes or chests which are kept floating in the dock; there the fish are stored till wanted for the market. These cod chests are 7 feet long, 4 feet wide, and 2 feet deep; the bottom is made of stout battens placed a short distance apart, so that the water penetrates freely to the interior, as it does also between the planks of which the sides and ends are built up. The top is wholly planked over, except in the center, where there is an oblong opening for putting in and taking out fish. This opening is closed by a cover when the chest is in the water. Two ropes or chains are fixed in the ends of each chest for convenience in moving it about and hoisting it out of the water. About 40 good-sized cod, or nearly 100 smaller ones, may be put into one of these chests, and will live there without much deterioration for about a fortnight. There are usually as many as 400 of these chests in the Grimsby fish-dock, sometimes all in use and containing from 15,000 to 20,000 live cod. Every day during the cod season a remarkable scene is presented here, and the same thing occurs at Harwich, although on a smaller scale, Grimsby and Harwich being the two ports where the live cod are stored. A certain number of fish being wanted for market, the

INCLOSURE FOR LIVE LOBSTERS AT VINAL HAVEN, MAINE. (See page 340.)



FISH-FLOATS OR LIVE-CARS IN REAR OF FULTON FISH MARKET, NEW YORK CITY.

salesmen make their preparations accordingly, and the cod are taken out of the chests and killed. I say killed, because the fish are not merely taken out of the water and allowed to die, but they are dispatched in a very summary manner. A chest of cod is brought alongside an old hulk kept for the purpose, and moored in the dock close to the market place; tackles from a couple of davits are then hooked on to the handles, and the chest is hoisted up till nearly clear of the water, which drains through the bottom and leaves the fish dry. The cover is then taken off, and a man gets into the opening and takes out the fish, seizing them by the head and tail. As may be supposed, the commotion among 50 or 60 cod just out of the water is very great, and it is often a work of difficulty to get a good hold of the fish; but, one after another, they are lifted out and thrown up to the deck of the hulk, when they come into the hands of another man, who acts as executioner; he grasps the fish tightly behind the head with his left hand, holds it firmly on the deck, and, giving a few heavy blows on the nose with a short club, kills it at once.

It is sometimes as much as can be done to hold down a large and lively fish on the slippery deck while giving it the coup de grâce; but the work is generally skillfully performed, and the dead fish rapidly accumulate into a large heap, whence they are taken to the adjoining quay to be packed in bulk in the railway trucks waiting close by to receive them. Each truck will hold about twelve score of good-sized fish, or a proportionately larger number of smaller ones. The fish thus killed and packed reached Billingsgate in time for the early market next morning, and are known in the trade by the name of "live cod," the manner in which they are killed affecting the muscles of the fish in some way that enables the crimping process to be carried out successfully some hours after the fish have been taken out of the water. These cod command a high price, and are looked upon as essentially "West End" fish. There is, of course, a great advantage gained by thus storing the cod alive, for not only is the market more regularly supplied than would otherwise be the case, owing to small catches during bad weather, or delays from calms or adverse winds, but the fish themselves also come into the hands of the fishmongers in a fresher state than almost any other kinds supplied to them.

In connection with its hatching operations at Woods Hole, Mass., the U. S. Fish Commission retains live cod in cars, and for protection in stormy weather these are sheltered in an inclosure. The method is as follows:

The fish are taken with hand lines fished from the deck while the vessel is drifting in water from 10 to 40 fathoms deep. Those taken in the shoaler water are preferable to those coming from deep water, as the change to the shallow cars in which they are held at the station is less pronounced. Great care is exercised in catching the fish, for when hastily hauled up from deep water they are very liable to be "poke-blown"; that is, they have their stomachs turned inside out through the mouth. When drawn in with moderate speed, they become adapted to the gradually diminishing pressure and do not suffer injury. It is also important in unhooking the fish not to injure its mouth any more than is absolutely necessary, as the wound caused by the hook frequently spreads and forms a large sore and eventually kills the fish. All the vessels which collect cod for the station are provided with wells, in which the fish are placed and held while in transit. When a vessel arrives at the station with cod, the fish are immediately transferred with dip nets from the well to live-cars 16 feet long, 6 feet wide, and 5 feet deep, which are constructed of wood and divided into two compartments by a crosswise partition. As the fish obtained from smacks are paid for by the pound, it is customary to weigh about 10 per cent of each load and estimate the total weight by the average of those weighed. While being weighed, the cod are also counted, about 500 being put in each car. The cars are moored in the middle of a pool or basin protected on all sides by a wharf, which breaks the force of the sea in stormy weather and affords a sheltered place for handling the fish and taking the eggs. Cod take little or no food when spawning. The impounded brood fish are often tempted with fresh fish and with fresh and salted clams. (Report U. S. Commissioner of Fish and Fisheries for 1897, pp. 200-201.)

In the catfish trade centered at Morgan City and Melville, La., very substantial live-cars are used in transporting the catch from the fishing-grounds to the markets. These are built in the shape of a flat-bottomed skiff, sharp at each end, the sides, top, and bottom being formed of slats, with space between each slat for the free circulation of water. They range in length from 18 to 30 feet and about 5 feet in width. At each end there is a water-tight compartment with about 40 gallons capacity, and by emptying or filling these compartments with water the buoyancy of the car may be regulated.

Since the cars are usually towed by steam tugs at a speed of 6 or 8 miles per hour, the determination of the proper buoyancy at either end suitable for towing requires considerable judgment and experience.

These cars are divided by a slat partition into two or more compartments, so that the fish will not all crowd together. Their capacity is from 5 to 10 tons of fish, dependent on the temperature and condition of the water. During warm weather, or when there is considerable sediment in the water, the tugs usually carry ice in which the fish are packed in preference to carrying them in the live-cars.

The fishermen catching hogfish along the coasts of Virginia and North Carolina usually transport them in live-cars to the marketing ports, and the same is true in a number of other minor fisheries of the coast. In the sea bass and tautog fisheries prosecuted on the southern coast of New England the fishermen occasionally use boat-shaped cars made of wood, sharp at both ends, with auger-holes in sides and bottom and with top covered with hinged lid. A common size is 5 feet long on top, 3 feet long on the bottom, which is flat, and 2 feet wide on top at the middle.

Live-boxes are generally employed in the eel fishery of Connecticut, Long Island, and other places on the Atlantic coast, but these conform to no established shape or size, suiting the convenience and needs of the individual fisherman. Several of the catfish fishermen of Philadelphia retain their catch for several days or even weeks by putting them in large boxes lined with tin, which are placed in their yards and kept covered over, the water being changed frequently.

In this connection it may be well to describe the cars used in the Penobscot by the United States Fish Commission in transferring live salmon from the fishermen's weirs to the retaining ponds, preparatory to stripping them of spawn for hatching purposes:

The car employed is made from the common dory, divided transversely into three compartments. The central one, which is much the larger, is occupied by the fish, and is smoothly lined with thin boards and covered with a net to prevent the fish jumping out or being lost by the car capsizing, which sometimes occurs, while to guard them from fright and the rays of the sun a canvas cover is drawn over all.

The first cars of this form constructed had iron gratings to separate the central from the forward and after compartments, the water being admitted through the forward and discharged through the after compartment, but this was objectionable because the salmon were constantly seeking to escape through the forward grating, and often injured themselves by rushing against it. Smooth wooden gratings were afterwards used, and for many years cars were employed in which the compartments were separated by tight board partitions, the openings for the circulation of water communicating through the sides of the boat directly with the fish compartment, and being, of course, grated. This was very satisfactory, but when it was found desirable and practicable to use ice in transportation the forward compartment became the ice room, and it was necessary to perforate the partition again to admit the cold water to the fish. Finally, stout woolen blanket cloth was substituted in the partitions, with eyelet holes wrought in to afford passage to the water. This is the form now in use, in which the water is admitted through openings in the sides to the ice room, from which it passes through the fish room to the after room, whence it is discharged. The car is ballasted so that the rail is just above water, or, in case of an unusually large load of fish, a little below it. All the openings communicating with the outside are controlled by slides, which can be closed so as to let the car swim high and light when it is towed empty.

To avoid injury to the fish in transferring them to the cars, fine minnow dip nets, lined with woolen flannel of open texture, are used. The bow on which the net is hung is 22 inches in diameter, and to secure a net of ample width three ordinary nets, 36 inches in depth, are cut open down one side quite to the bottom, and then sewed together, giving thus three times the ordinary breadth without increasing the depth.

The collection of salmon is begun each season usually from the 20th of May to the 1st of June, but as the maximum temperature that the fish fresh from the weirs will endure is about 75° F., the

temperature of the water through which the cars are towed must be taken into consideration, and the collection not be postponed until too late in the season. If the collection is prolonged, this difficulty is obviated by using ice, as it has been found that by moderating the volume of water passing through the car and introducing it all through the ice compartment it is possible to keep a uniform temperature in the compartment in which the fish are held several degrees below that of the water in the river, thereby insuring the safe transfer of the salmon. (Report U. S. Commissioner of Fish and Fisheries for 1897, pp. 32–33.)

The live-cars used by the lobster dealers on the New England coast are usually substantially constructed, of large size, and divided into compartments. Those at Portland, Me., are mostly 30 feet long, 12 feet wide, and 3 feet deep, with capacity for 2,000 to 3,000 lobsters. The framework consists of six rectangular frames, 6 feet apart, to which are nailed boards 6 inches wide and 1 inch thick, forming the top, bottom, sides, and ends, with spaces of 1 to 2 inches between the adjacent boards. The cars are thus divided into five transverse compartments, each of which is provided with two large doors entering from the top, one door on each side of the middle line of the car. The cost of each approximates $60, and they last four or five years. At Portland there are about sixty of these cars, providing storage capacity for 150,000 live lobsters, which may be retained for three or four weeks under favorable conditions.

The usual size of the lobster cars employed at Boston is 28 feet long, 14 feet wide, and 5 feet deep, divided into four compartments, each of which holds from 500 to 800 lobsters, according to the season. The compartments are separated from each other by vertical lathes, and each has two doors opening from the top. Some dealers omit two or three of the middle lathes in each partition between the compartments, so that when the doors in the two middle ones are opened the light causes the active and more healthy lobsters to scurry into the end compartments, where, huddled closely together, they are more easily removed with a dip net. The weaker lobsters, being less active, remain behind, and, thus separated from the stronger ones, may be removed as desired. During the first year after its construction the buoyancy of its material keeps the car afloat with the top slightly above the surface. But as it becomes water-soaked it is necessary to buoy it, which is accomplished by placing an empty water-tight barrel within the car at each corner. Small marine ways are usually built adjacent to the cars for convenience in raising them above the surface of the water. The cars cost $90 each. They last about five years only, their period of usefulness being shortened by the destructiveness of the teredo. There are 65 of them in Boston, with an aggregate carrying capacity of about 170,000 lobsters.

At Friendship and Tremont, in Maine, lobsters are retained in cars constructed on a plan invented and patented by J. R. Burns, of Friendship, and differing from the usual type in being divided horizontally into separate compartments, each about a foot in height, thus preventing the lobsters from crowding and killing each other by their own weight. Each compartment is provided with convenient openings at the sides, so that lobsters and food can be introduced as desired. The cars are about 35 feet long, 18 feet wide, and 6 feet deep, with capacity for 5,000 lobsters each.

In New York the market floats already described as being employed in connection with the live-fish trade are also used for retaining lobsters. The aggregate storage capacity of the floats at New York probably does not exceed 25,000 lobsters.

The cars used by the lobster fishermen of the New England coast are generally much smaller and more rudely constructed than those of the dealers. It is desirable to have them small, because of the convenience in removing the lobsters by hoisting

the cars rather than by bailing; but some are so large that bailing is necessary. In general their capacity ranges from 100 to 1,000 lobsters, and entrance is made through a door on the top. At Woods Hole, Mass., the cars are about 6 feet long, 4 feet wide, and 3 feet deep. At No Man's Land, Mass., the average size is about 10 feet long, 5 feet wide, and 3 feet deep, and some of them are constructed for breaking the force of the waves that beat against them, having the top and bottom converging toward the ends, which are somewhat pointed. Old dories provided with a cover and with numerous holes bored in the sides and bottom are frequently employed, but slat-work boxes are the most common.

While the size and form of the live cars or boxes are largely matters of local fancy and convenience, it is important that they be of sufficient capacity to hold the lobsters without crowding. In estimating the capacity of live-cars several modifying conditions must be considered, such as the roughness of the water, temperature, shade, etc. In localities where the water is still and quiet, fewer lobsters should be put in a car of definite size than in more exposed localities, because lobsters must have air as well as water. When the water is still the air is quickly exhausted and agitation of the water is necessary to replenish it. More lobsters can be carried in a given space during cool weather than when it is warm. The number that can profitably be put in a car depends also on the length of time they will remain there. In general, 150 lobsters to each 100 cubic feet of space is most satisfactory, although sometimes 300 and even more are placed in 100 cubic feet. In shallow cars a greater number of lobsters can be carried per 100 cubic feet than in deep ones. When given sufficient room, lobsters may be kept alive in these inclosures for several days or weeks, while awaiting the arrival of the market boat or while holding them for better prices. If the length of the confinement extends beyond a week or two it is desirable to feed the lobsters, otherwise they will eat each other. Any refuse fish which is not very oily is used for food. It is not advisable to confine them in live cars and feed them for the purpose of increasing the weight, and unless they are being held for a better market price the sooner they are removed from the car the better. The practice of plugging the claws of lobsters has been almost entirely abandoned.

OVERLAND TRANSPORTATION OF LIVE FISH.

Live fish are rarely shipped overland in the United States for commercial purposes, owing to the expense and also to the difficulty in keeping the water properly aerated and at the right temperature; but in connection with its work of stocking streams, etc., the United States Fish Commission is almost constantly engaged in work of that nature, adult fish as well as fry being carried in specially prepared tank cars on trips that last sometimes a week or more. The best type of these cars is described as follows in the report of the Commissioner for 1898:

> The dimensions of car No. 3 as rebuilt are as follows: Length of body, 60 feet; total length from end of platform to end of platform, 67 feet 10 inches; width, $9\frac{1}{2}$ feet; height from top of rail to top of roof, 13 feet 8 inches. The frame of the car is so braced as to permit of the two large doors in the center extending from floor to roof. This feature very materially simplifies loading and unloading. The interior of the car is finished in ash, and in one end is an office, an ice-box of $1\frac{1}{2}$ tons capacity, and a pressure tank holding 500 gallons of water; at the other end are the boiler room and kitchen. The boiler room is equipped with a 5-horsepower boiler, circulating water pump, and air and feed pump. The tanks and cans used in transporting fish are carried in two compartments running along

the sides of the car between the office and boiler room. They are 30 feet long, 3 feet wide, and 25 inches deep. Under the car, between the trucks, is a reservoir tank holding 600 gallons of water, and from which water is pumped into the pressure tank near the office; it then passes from this tank to the fish cans and tanks, and then back to the reservoir. In the middle of the car, over the compartments referred to, are four berths and several lockers for the use of the crew. The office also contains two berths, a writing desk, and a typewriter. These cars are fully equipped with all modern improvements in the way of brakes, couplers, signal whistles, etc., and have Pullman trucks and 33-inch Allen paper wheels. With the large water capacity provided, they are capable of carrying much greater loads of fish than ever before.

In transporting fresh-water species both water and air circulation are used, but with salt-water species the salt water is usually kept aerated by circulation only as it is not generally practicable to provide for a change of water. When the temperature is high, ice is sometimes packed about the transportation tanks to keep them cool, and in extreme cases a can filled with ice is placed in the water. In this manner marine species have been carried successfully for six days or more.

In the above-described cars the carrying capacity is to some extent sacrificed for the comfort of the crew, since they live on the cars throughout the year. Also the fish must not only reach their destination alive, but in a vigorous, healthy condition, so that they may live and be used in reproducing. Neither of these conditions is essential in transporting live fish to market, consequently a greater carrying capacity could be secured in cars designed especially for that trade.

A method of operating the air-pump by means of the rotary motion of the car axles was attempted on the U. S. Fish Commission transportation cars. The experiment is thus described on page 241 of the report for 1897:

An arrangement was adopted to furnish power for the pump and an air-blower by means of a friction wheel placed on the truck at one end of the car. This wheel was attached near one end to the top of the truck, so that it rested on the tread of the car wheel and was held there by two spiral springs. When not in use it could be elevated above the car wheel by a lever operated from inside the car. Power was transmitted from the friction wheel by means of a countershaft and rubber belting. The friction wheel gave a great deal of trouble, however, as it was impossible to make it strong enough to stand the wear to which it was subjected. As the action of the truck springs while the car was in motion moved the truck frame up and down, sometimes 3 to 5 inches, the friction wheel would be jolted out of position, and so uncertain was its operation that it could not be relied upon, and the pump and blower had to be worked by hand.

As a general rule fish will carry best in water of a low temperature. Cold water absorbs more air than warm; it also lessens the activity of the fish, causing them to consume less oxygen, and it retards decomposition in the organic substances contained in the water and the consequent generation of noxious gases. The lowering of the temperature therefore offers a threefold advantage. Whenever practicable the fish should be kept in confinement without food for a day or two before being transported, so that there may be no danger of the water being made impure by excrements of the fish.

In Europe considerable attention has been given to transporting fish alive. Well-smacks are used in the North Sea fisheries prosecuted by Germany, Holland, and England. Live cars are employed by many of the shore fishermen, and in many of the fish-markets both fresh-water and marine species are kept alive in tanks. The difficulty of keeping sea fish alive when natural salt water can not be obtained is met by the use of artificial salt water. But the most interesting feature of the European fish marketing is the overland transportation of live fish.

In Germany fresh-water species are transported alive in barrels about three-fourths full of water, the quantity of fish to each barrel depending on the variety, the length of the journey, and the season of the year. During the journey the water in the barrel is in almost constant motion, presenting considerable surface to the air, so that during a short distance sufficient oxygen is in this manner introduced into the water. But if longer journeys are made air must be introduced, which is accomplished by filling a sprinkler with water and squirting this water into the barrel with considerable force from a short distance, or the water is agitated by a vertical paddle-wheel fastened on the upper part of the vessel and separated from the fish by a perforated wall. Some of the barrels are provided with a tube running almost to the bottom of the barrel, the lower end containing many openings, and through this tube air is forced by means of a bellows on the outside. The last method is preferred, for by its use the barrel may be filled with water and fish, the carbonic acid is driven off, and agitation of the water is avoided. In the manner above described fish can be kept alive for a considerable period in a quantity of water weighing much less than their combined weight.

In 1881 a company was organized in Germany for the wholesale transportation of fresh salt-water fish from Cuxhaven, on the border of the North Sea, to Berlin, in specially constructed cars. The form of car adopted was invented and patented in Germany by Arno Gustav Pachaly, a Bohemian.

The following description is from the German letters patent dated March 20, 1880:

The transporting vessel is a railroad car, which can be taken off the wheels, the walls of which are double, the intervening space being filled with nonconductors of heat. Inside the car, and resting on the double floor, there is a shallow tank of forged iron with a vaulted roof, in which is placed the live fish with a quantity of fresh sea water. Along the inside walls of the car are shelves for storing the dead fish, and ice-boxes attached to the ceiling serve to keep the air cool. With a view to supplying the live fish in the tank with the necessary oxygen, air is led by means of pipes from the top of the car into the ice-boxes in which it is cooled and then by means of an air-pump it is forced into the fish tank. This air-pump is connected by means of a belt with one of the axles of the car, so that the necessary power may be obtained while the car is in motion, and in order to protect the fish from suffocation during the stoppages the air pump is so arranged that it can be operated also by means of a crank. To prevent violent motion of the water the air above the water in the tank is kept at a slight pressure, this being regulated by a suitable escape valve in the roof of the tank.

SHIPPING LIVE LOBSTERS.

In shipping lobsters alive well-smacks are employed to a great extent where the transportation is in large quantities from one part of the coast to another, but much of the coastal shipments, as well as the great bulk of those overland, are made in barrels. Flour barrels holding about 140 pounds, or sugar barrels with 185 pounds capacity, are employed, in the bottoms of which several holes are bored to afford drainage. In placing the lobsters in the barrels, each lobster is seized by the carapax, the tail is bent up under the body, and it is placed in the barrel with the back uppermost, being packed quickly and snugly together, so that they can not move from the position in which they are placed. Unless the weather is cold a long, narrow block of ice, weighing from 20 to 40 pounds, is placed in the center, its length following the axis of the barrel. On top of the lobsters a handful of seaweed is placed, and this is covered with 5 to 20 pounds of crushed ice, and the whole is inclosed by sacking secured under the upper hoop of the barrel. Packed in this way, the lobsters readily

survive a trip lasting three or four days. Some dealers have tried separating the lobsters from the ice, using for this purpose a long, narrow box, divided transversely into three compartments, of which the middle is much the largest, and in this the lobsters are placed, while the ice is put in the two smaller compartments; but lobsters do better when in contact with the ice, the moisture appearing to be necessary for their preservation.

The United States Fish Commission has successfully carried live lobsters in its transportation cars for distances upward of 3,000 miles. The method pursued is thus described on pp. 243–244 of the report for 1897:

Large, mature lobsters, on long trips, are packed in seaweed in wooden trays about 6 inches high and of a size convenient for handling. Strips of wood attached to the bottom of trays have open spaces between them to allow air circulation. About 2 inches of seaweed are spread on the bottom of the tray and the lobsters placed on it with their claws toward the outer ends, so that they can not injure each other, and the trays are then filled with seaweed. They are packed in the refrigerator compartments, and the temperature of the air is kept, if possible, at from 40° to 48° F. A supply of salt water, filtered through cotton, is taken along, and the lobsters are sprinkled with it three or four times a day, and they are also daily overhauled and repacked. If the desired temperature is maintained, 50 to 60 per cent can be carried for five or six days.

Attempts have been made to ship live lobsters in sea water by having a water tank with a series of shelves either communicating or separate, with supply and discharge pipes connecting with the shelves, so that the lobsters on each shelf may be kept supplied with fresh sea water. This apparatus was intended especially for transporting lobsters on shipboard to England, but it has not been used to any great extent.

The following article from the *Canadian Gazette*, of London, contains an account of the experiments with it:

The Canadian lobster has long been well known and appreciated in England, but only in its preserved state, packed in the tins familiar to all housekeepers. A successful attempt has just been made to import live lobsters from Canada, where they are abundant and cheap, to England, where they are so dear as to render them a positive luxury. Many attempts have been made at different times to land live Canadian lobsters in England, but none of them had proved successful, owing to various causes too numerous to explain here. The idea was, however, too good, too tempting, to be definitely abandoned, and experiments were constantly being made, though with but little success. Finally Messrs. Arthur and Harold McGray instituted careful inquiries in the principal lobster districts, the result of which led them to the conclusion that the methods adopted by previous shippers had been defective, owing to their ignorance of the habits and requirements of the lobster. These shippers had simply placed the fish in large tubs, renewing the salt water at frequent intervals. This was clearly insufficient, for the lobsters invariably died within 12 or 15 hours. Having concluded their inquiries and carefully tabulated the information they had obtained, Messrs. McGray commenced to experiment with a system entirely different, devised by themselves. This improved apparatus, which appears simple in itself, is the outcome of patient observation and study of the habits of the lobster at various points along the coast. It enables the crustaceans to continue while in transport an almost identical mode of life to that led by them at the bottom of the sea. This system constituted the inventor's secret, which we cannot of course divulge at the present moment. They commenced with ten lobsters, which they placed in their improved receptacle and contrived to keep them alive for 48 hours. This was a decided improvement on the results previously obtained by other merchants. Thus encouraged, they continued their experiments with successive series of lobsters. In the course of the summer of 1891 they succeeded in keeping them alive 5, 8, 11, 13, and ultimately 18 days. These experiments, diversified by innumerable incidents, trials, failures, and partial successes, were conducted on board a light-ship stationed off Barrington, with water always taken from the bay and naturally of about the same temperature. An important point was thus established—lobsters could be kept alive for 18 days on board a stationary ship.

The question then arose, would similar lobsters live the same length of time on board a ship crossing the Atlantic, and in water constantly changing in temperature? Messrs. McGray were quite convinced that they would. They, therefore, arranged to ship 50 lobsters by the steamship *Historian*, running from Halifax, Nova Scotia, to London direct. The passage was expected to occupy 14 days. This was more than sufficient to thoroughly test the system, seeing that steamers are available which make the passage in 10 days. The ship left Halifax at 8 a. m. on Thursday, December 10, Mr. Harold McGray being on board to personally conduct the experiments. The lobsters were shipped under rather unfavorable circumstances, they having then been out of water for 24 hours. The losses during the voyage were as follows: On the first day 2 lobsters died; on the fifth day, 4; on the sixth day, 1; on the seventh day, 3; on the eighth day, 1; on the ninth day, 1; on the twelfth day, 2.

The fifth day a receptacle containing 15 lobsters was swept overboard during a southwest hurricane. The first 2 deaths were due to the unsatisfactory condition of the fish when shipped; the next 4 were killed by the rapid change in temperature during the passage across the Gulf stream; 2 died from injuries inflicted by larger and stronger ones, while the remainder died from some unknown cause.

On leaving Halifax the temperature of the water was 44°, and this was maintained for 4 days. On the banks of Newfoundland it varied from 45° to 48°, while, on arriving in the Gulf stream, it suddenly rose to 65°. Mr. McGray was naturally anxious to ascertain the effect produced on the crustaceans by this rapid rise in temperature. Four of them succumbed, as we have said; but the rest remained in good condition.

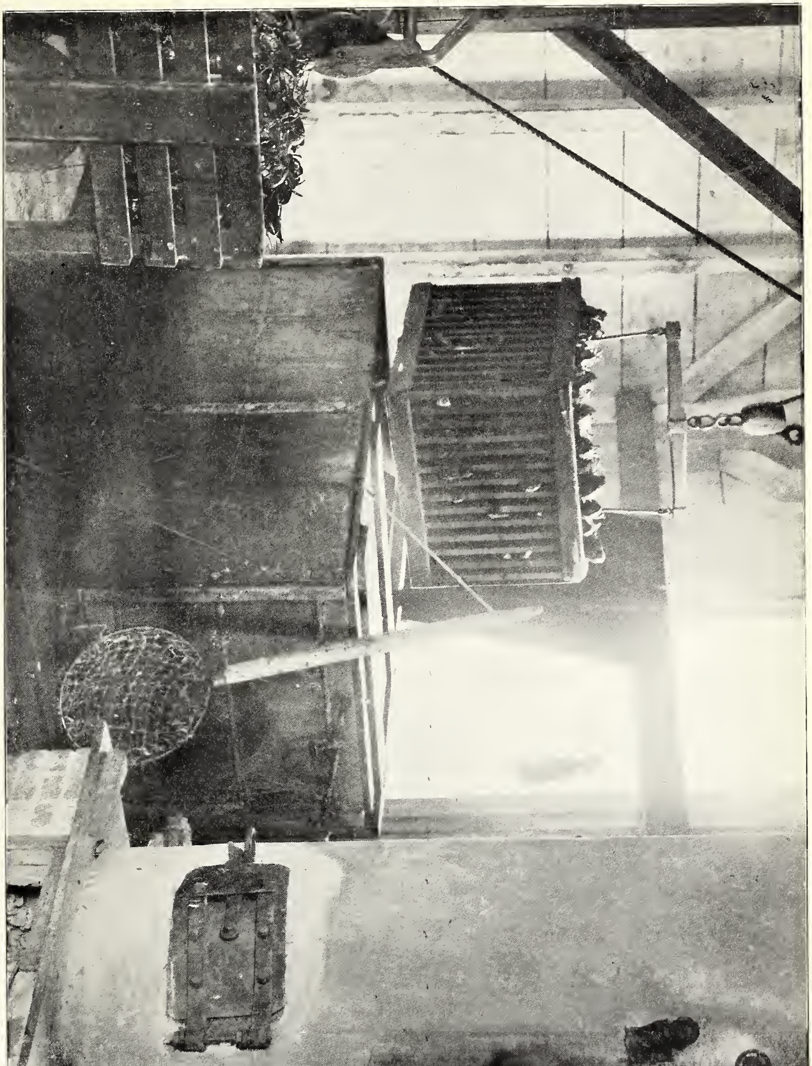
Strange to say, the cold air and the warm water exercise an equally fatal effect on these delicate fish, accustomed to live in depths where the air never penetrates, and where the water never rises above a certain temperature. Another curious point was that they traveled the entire distance—2,800 miles—without requiring anything in the shape of food. When at the bottom of the ocean they eat fish, and when brought to the surface to be kept for a certain time they can be fed on oatmeal. They would, of course, eat fish, but it has been found that they fight for this food like hungry wolves, biting and seriously injuring one another. To avoid all possible risk Mr. McGray decided to give them nothing to eat and found that they still remained in good condition.

Up to the time of the arrival of the shipment in the Victoria docks, at noon on December 26, everything had come up to the expectations of the exporters. Unfortunately, however, they reached London just at the time when, owing to the Christmas holidays, the markets were closed for 3 days. They had consequently to be kept on the ship for nearly 2 days, until the morning of Monday, December 28, and the water in the dock had to be used in the endeavor to keep them alive. That dock water, helped by the fog, killed all but four. It will, however, be admitted that these quite exceptional circumstances do not detract from the value of the experiment, as showing that live lobsters can be brought to this country in a marketable state, and Mr. McGray is confident, from the experience he has gained, that the next shipment will establish beyond doubt the feasibility of a successful and profitable trade.

The practicability of the transport of live lobsters having been thus far demonstrated, the promoters will later on arrange for the acquisition of a 15-knot boat specially fitted with the necessary apparatus for the conveyance of live lobsters in large quantities across the Atlantic. This will enable them to supply the markets of London and Paris with first-class lobsters delivered alive in those cities at less than half the price now paid for English lobsters of equal quality.

Mr. Adolph Nielsen, fishery expert connected with the Newfoundland Fisheries Commission, thus discusses the practicability of shipping live lobsters to Europe:

The exportation of lobsters alive to England and the European Continent is a matter which has occupied my attention very much, and is worthy of the Fishery Commission's greatest attention, because if it could be carried out successfully it would mean a large increase in the value of the lobster fishery. The greatest difficulties to be overcome in carrying lobsters alive in large quantities for a long distance is to prevent them from crowding together on top of each other if shipped in bulk, in which way a large number of them suffocate, and to keep them alive for any length of time in hot weather in the summer, especially in water of a high temperature. Several experiments have been made in the United States with shipments of lobsters alive in the hot season in vessels built for the purpose, fitted out either with wells or after other plans, but as far as I am aware the attempt has not yet been successful. I saw a few years ago a steamer fitted out to carry lobsters alive from Nova Scotia to the States. She had her hold divided into compartments, which were intended to be filled



BOILING LIVE LOBSTERS PREPARATORY TO SHIPPING IN ICE, SHOWING BOILER, STEAM TANK, CAGE, ETC.

with the live stock. Along the keelson was laid a pipe through which water forced in from the bow. This pipe was furnished with a valve so that the water could be shut off and let in according to wish. From this main supply pipe smaller perforated pipes were laid around the bottom of each compartment. The idea of this system was to obtain a strong current of water upwards, which it was thought would keep the lobsters from crowding together on top of each other and smothering. I was informed that this system worked well enough in a cold season, but noticed myself that it was condemned in the summer months, and that the lobsters were packed in boxes with ice and shipped away to the States in this way in the same steamer. The difficulties in keeping the lobsters from crowding together and smothering, and in keeping the water cold in a vessel while crossing the Atlantic, I think could easily be overcome, and I even think it would be sufficient to bring the temperature of the water down while crossing the Gulf Stream in the summer months.

My plan would be to divide the hold of the vessel into compartments and have each compartment again floored over with boards 3 to 4 inches apart through its whole height. These boards could be put down and fastened according as the vessel was loaded, and taken up according as it was discharged. In this way the difficulty of keeping the lobsters from crowding on top of each other would be overcome. The height of water in the compartments could be regulated according to wish while loading or discharging. By means of refrigerators the temperature of the water could be brought down at a little expense whenever it was found too high. In this way I am of opinion that lobsters could be kept alive in good condition for a considerable length of time. Steamers would be preferable to sailing vessels. The collection of lobsters could easily be arranged by having fixed stations in a bay, at which the vessels could call and take in their cargoes, and I am sure there would not be much trouble, nor would it take a long time to secure full loads when everything was well arranged. * * * With the great demand and high prices paid for lobsters alive in England and on the Continent, there is the best reason to anticipate that a large and profitable business could be done in carrying these crustaceans across the Atlantic alive. When it can pay English people to send their vessels up to the western coast of Norway, where the lobsters are far from plentiful and where only a limited quantity can be secured, and purchase there at a high figure and carry them alive to England every year, it is reasonable to presume that it would pay very much better to ship them from Newfoundland, where they can be secured in much larger quantities and at a very small cost, if the difficulty in bringing them across the Atlantic alive can be overcome. (Report of Newfoundland Fisheries Commission for 1890, pp. 54-56.)

While lobsters are generally shipped alive, yet some are first boiled and then cooled and placed in barrels or boxes, and if the weather be warm some ice is added. Boiling before shipment is applied to about one-eighth of the lobsters handled on the United States coast. They are boiled in salt water in a covered box, to which steam is admitted for 20 or 30 minutes, the temperature being about 250° F. On removal they are carefully folded and placed in piles like cord wood for cooling, when they are packed in a manner similar to live lobsters. They will keep a week or longer when well iced. Only live lobsters are boiled, for after death the muscles so relax that the fibers become short and the meat crumbles, not having sufficient tenacity to hold together, and the tail bends readily upon slight pressure. Lobsters that die before being cooked are so much loss, since they are not then suitable for food markets.

SHIPPING LIVE OYSTERS AND CLAMS.

While the great bulk of oysters and clams produced in this country are opened before being marketed, yet there is an extensive trade in these mollusks in the shell, not only at markets near the source of supply, but at points quite inland, and even in foreign countries. When out of their native element, oysters and clams will ordinarily live only a few days, and in order to retain them alive during shipment and in storage prior to consumption it is necessary to keep them cool and to prevent the loss of liquor from the shell. With care they may be retained in this manner for months. Half a century ago it was customary with many families in Connecticut and New York to lay

in a supply of oysters every fall for use during the winter. Piled up in some cool place, usually in the cellar, with the deep shell downwards and between layers of seaweed, they would live sometimes for three or four months. At present during cold weather it is not unusual for them to remain in bulk in the holds of vessels for two or three weeks without great deterioration of quality, and they are at times kept as long in the holds of the oyster scows in the New York market, or in the cellars of other wholesale depots.

At several points along the Atlantic coast, and especially at Franklin City, Va., very convenient floats for storing oysters or clams are so arranged in the water adjacent to the market-houses that they may be raised or lowered by means of windlasses. The most convenient size of the floats is 20 or 25 feet long, 8 or 10 feet wide, and 2 or 3 feet deep, the sides and bottom being of strong slats. Four piles are driven into the ground, two at each end of a float, and on these rest the windlasses for raising the float when it is desirable to remove the oysters.

An interesting feature in connection with the marketing of oysters is practiced in Connecticut, New York, New Jersey, Virginia, and a few other localities, viz, the "drinking" or "freshening" of oysters. The oysters are removed from the reefs or planting-grounds and placed in floats or on private areas near the mouth of a small stream of fresh water. Here they at once eject the mud and other impurities within the shells and clinging to the edges of the mantle and gills, and imbibe a large quantity of fresh water, improving the color of the flesh, making it a purer white and bloating it into an appearance of fatness. From 10 to 36 hours is the usual length of time the oysters remain in fresh water before being marketed. The same result is accomplished in some places with the aid of platforms of rough planking set in the river bank, on which oysters are thrown at high tide and are left bare by the receding tide; a sluice-gate is then opened and fresh water is allowed to flow over them.

A more elaborate affair is constructed in the following manner: The shore or bank is excavated and piles are driven until a floor can be laid at a suitable level below high-water mark. A tight shed is built over this, and on one side a canal is dug, into which a boat may run and its cargo be easily shoveled through large openings in the side of the shed upon the floor within. As the tide recedes it leaves the oysters upon the platform within the shed nearly bare, a depth of 8 or 10 inches of water being retained by a footboard at the seaward end of the shed. By an arrangement of sluices the fresh water is then admitted and the freshening begun, and the bulk of salt and of fresh water can be so proportioned as to impart the degree of freshness desired. At a height of 7 or 8 feet above the oyster platform or pen is another platform or garret where barrels, baskets, boat gear, and other small property can be safely stowed.

When oysters are removed from bulk, and subjected to the varying conditions met with in transportation, greater care must be taken, especially to prevent loss of the liquor, and, secondarily, to maintain a moderately low temperature.

In shipping short distances, merely placing the mollusks in barrels or in bulk is sufficient if the weather is cool. For longer shipments, or in warm weather, they must be packed more carefully, and some shippers place each oyster with the deep or concave shell underneath and press the head of the barrel down tightly. Refrigerator cars are used to some extent during both warm and cold weather, and when the destination is reached, if not intended for immediate consumption, oysters should be kept at a temperature between 35° and 45°. If they become frozen they should be thawed gradually in a cool place. Oysters will not freeze as readily as clams; and

oysters and clams in transit during a snowstorm do not freeze as readily as when the weather is clear and a stiff wind prevails.

The European trade in American oysters depends on shipments of live oysters. This began in 1861, and a trade has been built up amounting to about 100,000 barrels annually, small East River and Long Island oysters being selected, averaging 1,200 to 2,000 to the barrel. The oysters are packed as snugly as possible in the barrels, sometimes with the more concave shell underneath, to prevent escape of liquor, and all are pressed down tightly by the cover, to keep the shells of the oysters closed. In shipping, the barrels are stowed, head up, in some part of the steamer where they may keep cool, and two or three weeks frequently elapse from the time of gathering them until their bedding or consumption in England.

A large proportion of the oyster trade on the Pacific coast depends on the transportation from New York of seed oysters, running from 2,000 to 7,000 to the barrel. These oysters are transported during the spring and fall, carefully packed in barrels, in carload lots, and are usually two or three weeks on the road, being carried on fast freight trains. Unless the weather conditions be unusual they survive the journey with small loss, usually about 10 per cent. It is not considered injurious if the liquid about the oysters freezes, provided the mollusk itself does not freeze. In illustration of the vitality of these small oysters it is stated that several years ago, in a shipment of several carloads, one car was missent through some blunder, and on reaching San Francisco, after being two months on the way, the percentage of loss among the oysters, which were already partly frozen, was but little more than ordinary. The cost of the seed at New York is about $3.50 per barrel, and the transportation charges are about $5 per barrel. During some years as many as 100 carloads, of 85 to 95 barrels each, are planted in Pacific coast waters, principally in San Francisco Bay.

In 1882 a patent* was issued for a somewhat unique method of preparing oysters and other mollusks for long shipments. It consists in binding the shells firmly together, while the mollusk is fresh and alive, by means of a wire or wires made to embrace the shells between which the animal is contained, the ends of the wire being secured by being twisted. It is claimed that by this process the natural juices are retained and the deterioration in quality which ensues upon their evaporation is prevented.

Prof. John A. Ryder is quoted as indorsing the value of the method as follows:

> I have examined and had in my possession a number of wired oysters, and I am satisfied that the oyster can be preserved, when the shells are thus wired, for a considerable length of time. I have carefully examined oysters, which I am satisfied have been wired for 60 days, and I find that their vitality is fully preserved and the oyster in no way deteriorated in quality or flavor. I think the process of preserving oysters by placing a wire around them is a practically useful process, and, in my opinion, would lead to the transportation of oysters to distant points as an article of commerce, when it would otherwise be impossible to transport them alive in the shell.

The method was employed on a small scale in Philadelphia for several years, and in 1888 a stock company was formed and a plant established at Cape Charles, Va. At first the work of wiring was done with pliers, but in 1890 special machines were introduced, by means of which one man has been known to wire 48 oysters in a minute, but the average is much less. The shipments extended quite over the country in an experimental way, many being sold on the Pacific coast. A few oysters are yet shipped in this manner, but the practice has not come into general use.

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*No. 265255, dated October 3, 1882.

A number of other methods have been proposed for fastening the shells of oysters together, such as inclosing them in a batter of plaster of paris or similar material,* securing a rivet of soft iron through the nib or bill,† inserting a plug of hard wood or other suitable material between the shells immediately in the rear of the hinge,‡ etc.

A railroad car for the special transportation of live oysters, invented by Mr. A. E. Stilwell, of Kansas City, Mo., has been used to some extent during the last year or two on the Kansas City, Port Arthur and Gulf Railroad. The interior of the car is 34 feet long, 8 feet wide, and 4 feet high, the space being divided into four compartments, each of which has two ventilators in the top through which the oysters are loaded, and two unloading spaces in the side. The floor and sides of the car are constructed of 3-inch white pine, calked and pitched in the manner of ships, so as to make the compartments water-tight. These compartments are first nearly filled with oysters, and then sufficient sea water is added to cover them.

SHIPPING LIVE CRABS.

Hard crabs require little care in packing and shipping. They are placed, back up, in barrels or boxes, usually without ice if the weather be cool, and covered with cloth. Little mortality occurs if their destination be reached in two or three days. But during warm weather a block of ice, weighing 5 to 15 pounds, is placed in the top of the barrel and separated from the crabs by a double handful of wet seaweed. The receipts of hard crabs in the markets are quite extensive, the supply being obtained at various points along the coast, but principally from the shores of Chesapeake Bay. From that bay about 75,000 barrels are marketed annually, each barrel holding from 200 to 300 crabs, which weigh about 75 pounds.

Much greater care is required in handling soft-shell crabs. This industry originated about 1873, and it has reached its greatest development at Crisfield, Md., but supplies are received also from New Jersey, Virginia, North Carolina, Louisiana, and various other points. The soft-shell and "peeler" crabs are caught together, the former being shipped at once and the latter impounded until after the shedding process and then shipped to market. The present trade amounts to about 16,000,000 crabs annually, worth 2 or 3 cents at the fishing port, and from 3 to 10 cents each in the retail markets. The peeler crabs are impounded in floats made of light plank and scantling, with plain board bottoms and latticed sides. The size of the floats varies somewhat, but most of those at Crisfield are 20 feet long, 3 to 5 feet wide, and 15 inches deep, with a projecting ledge at half their height corresponding to their water line. The average value is about $2, with a capacity for 300 or 400 crabs each. They are frequently inclosed by a board fence, which serves as a breakwater. The floats are visited three or four times daily, and the crabs that have shed since the last visit are taken out and at once marketed.

The following, in reference to the live-crab business, taken from an article by Hugh M. Smith, in the Bulletin of the United States Fish Commission for 1889, is of interest in this connection:

> The one factor which, more than any other, tends to reduce the profits of the shippers and indirectly the receipts of the fishermen, is the high death-rate among the impounded crabs. Owing to the injuries which many crabs receive in being caught and handled, and, in a measure, to the severity of the shedding process, a comparatively large number of crabs die after being purchased by the dealers,

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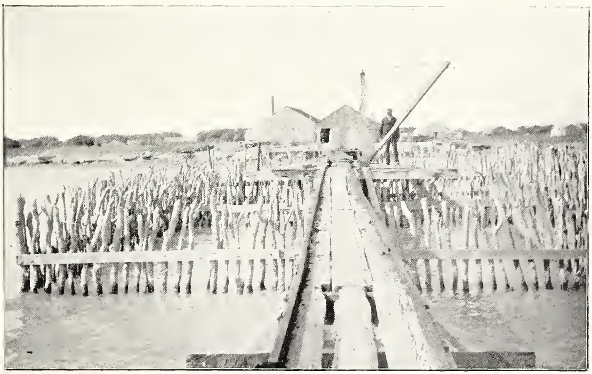
* See Letters Patent No. 431212, dated July 1, 1890.
† See Letters Patent No. 453144, dated May 26, 1891.
‡ See Letters Patent No. 459220, dated September 8, 1891.

PACKING LIVE HARD CRABS IN BARRELS FOR SHIPMENT AT OXFORD, MARYLAND.

FLOATS FOR SOFT CRABS AT OXFORD, MARYLAND.



GREEN-TURTLE PEN, FULTON, TEXAS. (See page 341.)

and are a total loss. As an illustration of the uncertainty of the business and of the risks which the dealers have to run at times, it may be stated that of 3,200 crabs purchased by a firm one day in July, 1888, no less than 3,000 died before shipment. This, of course, is an unusually great loss, and is not to be taken as a basis, although the individual dealers estimate their losses at from 10 to 30 per cent, and even as high as 50 per cent during certain periods. A few crabs die after leaving the hands of the shippers on the way to their destination, but this element of loss is being overcome by greater care and experience in packing the crabs prior to shipping them. A comparison of the total catch with the aggregate shipments for 1888 gives a difference of 628,766 crabs, with a market value of about $23,600, which figures represent the mortality and consequent losses. The death rate in 1887 was even higher than in 1888, being 21 per cent, as against 16 per cent in the latter year. It is impossible to determine with accuracy the number of crabs which die during shipment to market. There seems to be no remedy for this state of affairs. Although the season of 1888 showed a small but gratifying improvement over the previous year, it can hardly be hoped that the mortality will ever be reduced below a somewhat high limit, owing to the methods of capture and handling, and to the normal vicissitudes of the molting process, increased as they are by the unnatural surroundings and conditions to which the crabs are subjected.

The crabs are shipped to market in crates or boxes. The crates used in the Chesapeake region are about 4 feet long, 18 to 24 inches deep, and the same in width, and are provided with closely fitting trays, in which the crabs are carefully packed side by side, with their legs well folded up and their bodies lying obliquely, so that the moisture may not run from their mouths, in rows between layers of cold seaweed, on which finely crushed ice is sometimes placed. The capacity of each crate is from 8 to 10 dozen, and as the crabs possess little tendency to move when once packed in position, they remain quiescent for a long time. The principal markets for soft-shell crabs are New York, Philadelphia, Baltimore, and Washington, but the demand from the interior is increasing. In some localities the crabs are carefully placed in stout boxes in rows and tiers or layers separated with cold, moist seaweed, and with crushed ice in the top of the box over all, the entire contents being so arranged that the respective positions of the crabs can not be disturbed.

TERRAPIN AND TURTLES.

Among fishery products that are nearly always marketed alive are the various species of edible terrapin and turtles. These reptiles are remarkable for their tenacity of life; with very little care they may be retained alive for six months or more. In the Middle Atlantic States terrapin caught in summer or fall are usually placed in dark inclosures, as in cellars, with a quantity of seaweed or grass, into which they may burrow, and without food or water they are kept in excellent condition until the following spring.

It may be remarked incidentally that terrapin and certain kinds of fresh-water fish, as catfish and pike, may be frozen alive in a block of ice, and kept there for several days at least, and on thawing the ice the animals are found to be unharmed. I am not aware that experiments have been made to determine how long they will live under these circumstances or the lowest temperature they will stand.

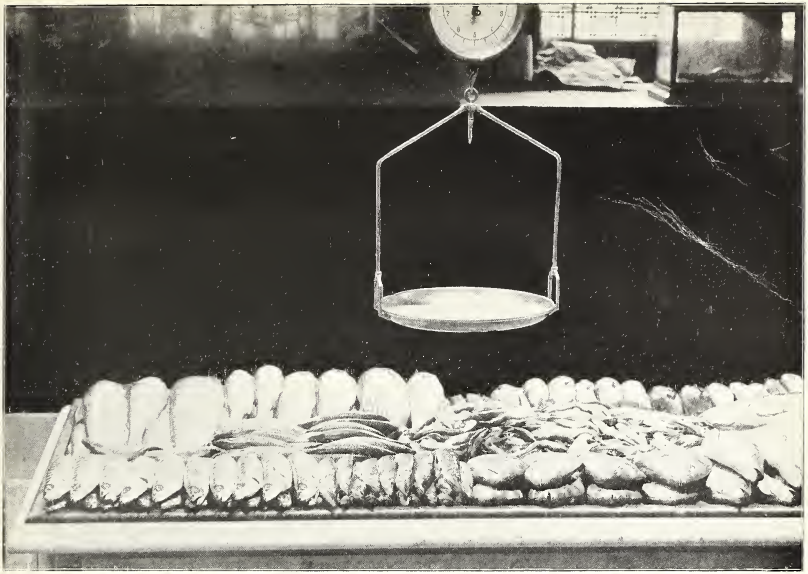
There are numerous inclosures along the Atlantic coast where terrapin are confined throughout the year for growing and breeding purposes, but this interesting feature of our fisheries is scarcely within the scope of the present chapter.

REFRIGERATION, OR PRESERVATION BY LOW TEMPERATURE.

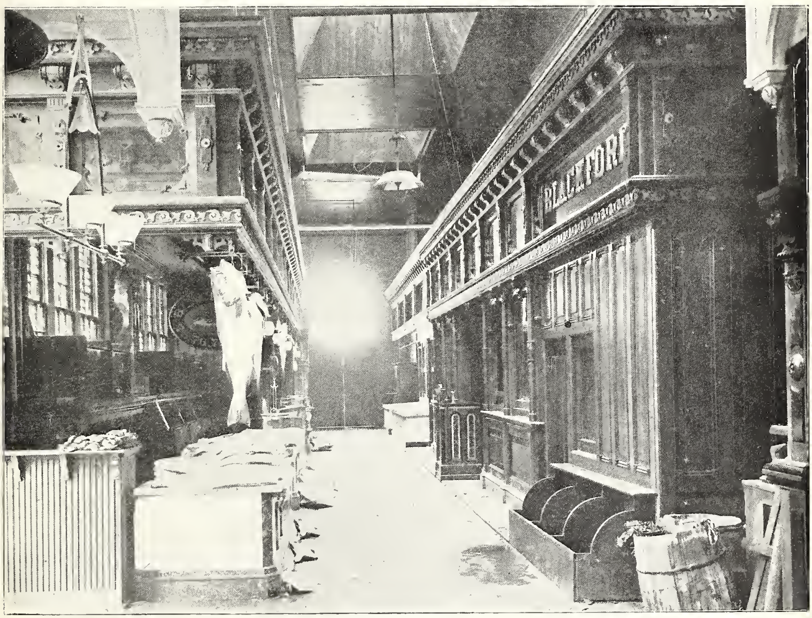
The temperature of fish, unlike that of mammals and other warm-blooded animals, corresponds to that of the medium in which they live. The atmosphere during the day being usually warmer than the seas and rivers the temperature of fish is generally increased on their removal therefrom and their consequent death, whereas in case of most land animals death usually results in a decrease in the temperature. This increase in temperature, together with the delicacy of the texture of flesh and the very large number of bacteria in the atmosphere to which the flesh is unaccustomed, makes fish extremely susceptible to putrefaction soon after life is extinct, especially if there be considerable moisture in the stomach cavities. In order to overcome this tendency it is important, in case fish are to be used fresh, that the temperature be kept at a low point while they are awaiting consumption. As the markets are generally situated at some distance from the sources of supply, preservation for a short time is a necessity, and for this purpose the application of low temperature is so general that it is almost coextensive with the fresh-fish trade in this country.

The importance of this method of preserving fish is not readily overestimated. It has resulted in a wonderful development of the Gulf and South Atlantic fisheries; and, indeed, without its agency the fishery resources of those regions would be of comparatively little value. It has enlarged and widened the general fishery trade so extensively that at present salmon fresh from the Columbia River, halibut from Alaskan waters, and oysters from Chesapeake Bay and Long Island Sound, are sold throughout the United States and in foreign countries, and numerous other fishery products are marketed thousands of miles from the source of supply, and for weeks after their capture, in condition not dissimilar to that when removed from the water.

It is only within the last half century that much attention has been given to the fresh-fish trade. Prior to 1830 it was of very limited extent, being confined during the warm months to a retail business in the towns near the fishing ports, while in winter the fish were frozen naturally and transported to the neighboring markets, the business being largely in the control of peddlers. Following the introduction of ice, about 1830, the handling of fresh fish developed more extensively than any other branch of the fishery industries, and at present the quantity of fish marketed fresh in the United States is much greater than the quantity placed on the market in all other conditions. The increase in this trade is one of the most noticeable features in connection with the fishery industries. An important factor in developing and maintaining it is the improvement in transportation facilities—not only on shore but also in bringing fish from the sea to the fishery ports, the improvements in railway traffic, and the addition of fast types of vessels. This feature of the trade, however, is scarcely within the scope of the present paper, as it does not tend to preserve the product, although it serves better than methods of preservation.



A RETAIL FISH STAND IN FULTON MARKET, NEW YORK CITY.



A RETAIL FISH MARKET IN NEW YORK CITY.

The processes generally employed for retarding putrefaction in fish by low temperature are (1) simple cooling with block or crushed ice, (2) open-air refrigeration during cold weather, and (3) artificial freezing and subsequent cold storage. The first process is employed quite generally throughout all countries in which ice is obtainable, in transporting the fish from the source of supply to the wholesale markets and thence to the retail stands, and in preserving the fish while awaiting immediate sale. The second is used principally in the winter herring and smelt trade with the British North American Provinces, and the third in preparing them fresh for very long shipments and in storing them for several weeks or months to await a better market. All of these methods are of comparatively recent development, the oldest in general use—cooling with ice—being used commercially only about 70 years, and doubtless none of them have yet reached their highest development.

COOLING FISH WITH ICE.

Probably half of the fishery food-products in the United States are preserved in ice for transportation to the markets and in holding them for immediate sale, and this is also true with respect to England and possibly some other countries of northern Europe. The process does not result in freezing the fish, the resulting temperature being never less than 32° F. The ice adds greatly to the expense, especially in transportation, and confines the process to preserving fish for brief periods of time.

The use of ice for preserving fish in the United States began in 1838, when a Gloucester smack is reported to have carried ice with which to preserve the halibut dying in the well or killed before being placed there. For a number of years there was a strong prejudice against iced fish, almost equal to the present opposition to frozen fish, and it was not until 1845 that it became common for vessels to carry ice as a preservative. Care was at first taken that the ice be kept separate from the fish, being placed in a corner of the hold. It was soon found, however, that stowing the fish in crushed ice did not materially injure them, and this method was soon in general use and largely superseded the trade in live fish north of Cape Cod.

For many years after ice was introduced in the vessel fisheries it was still thought inadvisable to ship iced fish inland, and not until 1858 could New England dealers be induced to experiment in sending them as far as New York City, but as the experiment was successful a large trade was quickly developed, and iced fish are now shipped to all parts of the United States.

The usual method of applying the ice is to crush it and mix it with the fish in successive layers of ice and fish. The process requires no great skill, yet there must be a good knowledge as to the quantity of ice necessary, the most economical size of the pieces, the convenient form of the receptacle, and the manner of packing—all of which depend on the kind and quantity of fish, the length of time for which they are to be held, and the temperature of the atmosphere. Fresh fish should have the very best of care in handling at the originating point, be promptly and thoroughly chilled, and so placed in the shipping box or barrel that bruising and the possibility of an increase in temperature are reduced to a minimum. It is advisable that fish be killed immediately after capture, as this prevents their thrashing about and bruising themselves, and they remain firmer and bear shipment better than those allowed to die slowly. Bleeding the fish is very frequently advantageous, but it is rarely done unless the fish are to be dressed. The practice of piling freshly-caught fish en masse,

one upon the other to the depth of several feet, is extremely objectionable, especially when the weather is warm; since it unnecessarily bruises and heats the fish, causing putrefaction to set in much earlier than would otherwise be the case. Absolute cleanliness is essential at every stage in handling fish, care being taken to keep the market houses and the shipping boxes or barrels free from every particle of putrefying refuse, otherwise the fish will become infected with bacteria already developed and natural putrefaction will be thereby accelerated by several hours. To secure the highest degree of cleanliness all stationary storage compartments should have metal linings, since the wooden walls and floors of the compartments furnish a lodgment extremely favorable to the developed bacteria.

Much difference exists as to the dressing of fish before shipment to the wholesale markets, but in general it is best to ship them round, or just as they come from the water. The choice grades of fish should never be eviscerated or beheaded when intended for the fresh trade; but cod, haddock, bluefish, lake trout, and all large fish, such as halibut, sturgeon, etc., are usually dressed before delivery. In every case putrefaction would be retarded longer if the viscera were removed; but the round, plump appearance of the fish is thereby impaired, and in case of certain species, as shad and herring, the roes, which are highly prized, would thereby become wasted. Dressing the fish also decreases the weight 15 or 20 per cent, and sometimes even more, and a correspondingly higher price is expected for the dressed fish than for the round. The practice varies not only in different localities, but in the same locality at different seasons of the year. Mackerel caught in the vessel fishery between June 1 and October 1 are usually dressed by drawing the viscera out through the gill-openings, whereas those taken during the spring and fall are generally iced round. The whitefish received at Detroit and some other lake ports are commonly split and eviscerated, except that Lake Erie whitefish are nearly always sold round. These are caught mostly in the fall, when they are full of spawn, and if eviscerated they would decrease about 24 per cent in weight, and, moreover, many customers desire the spawn. The yellow pike are received round mostly, but those coming from the Dominion of Canada are usually dressed, in order to lessen the import duties.

The importance of the careful handling of fish and their arrangement in the shipping boxes is scarcely appreciated by the majority of the fishermen. In discussing this subject in the National Fishery Congress, at Tampa, in January, 1898, Mr. E. G. Blackford, of New York, said:

> As an example of the increased returns to the shippers from careful handling, I call attention to the fact that certain shipments of shad, going to the New York market from North Carolina, bring from 25 per cent to 40 per cent more than other shad from the same locality. For instance, a certain shipper from Albemarle Sound, North Carolina, pursues the following method: His shad are carefully taken from the nets and placed in a cold room until thoroughly chilled, then packed in boxes; first a layer of fine ice, broken into lumps no larger than chestnuts, is placed in the bottom of the box; then the shad are placed in rows, lying on their backs, making a complete layer on the ice; then a layer of fine ice is spread over the bellies of the shad, and on this layer is another row of shad; all the shad are packed in a similar way; then the top of the box is filled with fine ice and the cover nailed securely on. These shad reach the New York market in a perfect condition, and so well known has this shipper's mark or brand become that buyers are always on the lookout for this particular brand, and these shad are the first sold and bring the highest prices. On arriving in New York, the fish have not moved from their position in the box, the ice is still intact, and on opening the box we find all the fish to be in a perfect condition, each scale undisturbed, and the whole presenting the appearance of a glistening jewel just taken from a casket. (Bull. U. S. Fish Commission, 1897, pp. 157–158.)

No matter what kind of fish are shipped, they should be thoroughly chilled before being placed in the shipping box or barrel, whenever the time will admit. It too frequently happens that fishermen place the fish in shipping packages immediately after their capture or after they have lain in the boat several hours exposed to the heat of the sun. Having to contend with the warmth of the fish as well as the atmospheric heat, the ice packed with the fish melts very rapidly, whereas if the fish had been chilled before being packed they would carry for a much longer time, and less ice would be necessary in the shipping package, resulting in reduced transportation charges. Cooling the fish is generally best accomplished by laying them thinly on a clean floor or platform in the fish-house and spreading finely chiseled ice over them; but if the air is unusually warm they should be cooled in a suitably insulated ice-box.

It is of prime importance that the temperature of the fish be reduced as soon as practicable after they are caught. The sooner they are placed with the ice after coming out of the water the longer the fish will carry and the better their condition on reaching the consumer. On the death of the fish the tissues relax, and offer a favorable lodgment for bacteria, whereas the application of ice as soon as the fish are removed from the water hardens the tissues and counteracts the development of bacteria.

Mr. E. Le Clair, of the Baltimore Packing and Cold Storage Company, of Minneapolis, Minn., in writing on this subject, states:

While at Lake of the Woods four years ago, during the month of July, when the weather was warm, the writer took two boxes in the boat; one of the boxes was filled with fish as soon as they were taken out of the nets, without ice; the other contained about the same quantity of the same kind of fish, which were immediately iced, while they were yet alive, and a test was made as to the keeping qualities of the two. As soon as the boat reached the fish-house where the fish were dressed, the un-iced fish were immediately iced after having the inwards and gills removed, and the fish that had been iced in the box were also dressed and treated in the same way as the other un-iced fish were. The fish that were not iced when taken out of the nets became unfit for human food in six days, and the fish that had been promptly iced were kept in the shanty for two weeks and then shipped from Lake of the Woods here, a distance of 600 miles, in a refrigerator car, the boxes marked; and when the fish arrived they were found to be in good condition, and we reshipped the same fish to Butte, Mont., and never had any complaint of them. The time that elapsed from the time that the fish were taken out of the water until they were iced in the fish-house was two hours and ten minutes, but the weather and water were warm. It therefore is evident that the greater care exercised at the originating point as to the proper icing of fish, the better will be the result.

The quantity of ice used in shipping fish depends on the size of the package and the season of the year. During the summer months, for a shipment covering one or two days, 50 pounds of ice is generally required to each 100-pound box of fish, more in proportion being necessary for smaller packages and less for larger ones. This ice should be crushed quite fine, so as to completely surround the fish and yet not bruise them. It is generally better to "chisel" the ice than to crush it, especially for packing among the layers of fish, since crushed ice is generally somewhat coarse. "Chiseling" consists in planing the ice from a large block by means of a long-handled chisel, the face or edge of which is formed by three or four thin, sharp teeth.

The most usual forms of shipping packages on the Atlantic coast are the flour barrel, with 200 pounds capacity, and boxes holding 400 or 500 pounds of fish. The 450-pound box, so popular in the Boston wholesale trade, measures 42 inches long, 24 inches wide, and 18 inches deep, and the 500-pound box is 48 inches long, 26 inches wide, and 18 inches deep. Auger-holes in the bottom of the barrels and the edge-cracks in the boxes suffice for drainage of the water resulting from the melting ice. After

placing a shovelful of crushed ice in the bottom of the barrel, about 50 pounds of fish are put in, followed by succeeding layers of ice and fish, with a top layer of two or three shovelfuls of ice. In packing in boxes a layer of crushed ice is placed in the bottom, another in the middle, and a third on top, the fish being between, with their heads toward the ends of the box. During cold weather, or when shallow boxes are used, the middle layer of ice may be omitted.

The arrangement of the fish in the boxes differs according to the species and the individual ideas of the shippers. The common practice is to place the fish on their backs if round, and on their bellies if dressed; but sometimes, in case of small fish, two layers are placed together, backs to backs and bellies to the ice. Cheap fish, such as cod, haddock, etc., and other large split fish are usually not arranged in any particular manner, but are permitted to lie in the barrel as they fall, while shad and other delicate species must be carefully placed. Small or medium-sized fish are rarely eviscerated before being marketed, as they sell much better in the round.

If the fish are thoroughly chilled as soon as practicable after removal from the water and carefully placed in the shipping package, so that they will not be bruised or the temperature rise above 40° or 45° F., they will generally keep in good condition for two weeks or more.

Natural ice, being usually less cold, is generally more desirable for shipping fish than artificial ice, since it gives off its coldness quickly and the moisture coming in contact with the fish acts as a good conductor, and the fish are more rapidly cooled. But as artificial ice lasts longer, it is better for long-distance shipments, provided the fish have been thoroughly chilled before being placed in the shipping-box.

Among the most effective devices for holding and shipping fresh fish cooled by means of ice is the shipping-car used in the trade on the Great Lakes. This consists of a large box mounted on a four-wheeled iron truck, the size of the boxes ranging from 4 feet long, 2½ feet wide, and 28 inches deep, to 7 feet long, 4 feet wide, and 4 feet deep, with a corresponding capacity of from 800 to 3,000 pounds of fish. The walls of the box are made double, of tongued-and-grooved boards, with an intervening air space of 2 or 3 inches. The truck wheels range from 9 to 12 inches in diameter. A layer of ice is placed in the bottom of the box and then one or two layers of fish, succeeded by alternate layers of ice and fish, the latter, in case of two layers together, being placed backs to backs and bellies to the ice, and the whole covered by a layer of ice. Some of the large boxes were formerly so constructed that the upper half of one of the sides might be let down to facilitate placing the fish near the bottom of the box. But because of the tendency of this hinged side to become loose, that form of box is no longer used, and fish are placed in the bottom of the box by tilting it down on one edge, the side forming an angle of 45° with the floor and resting on a triangular frame or horse.

The cars average in value about $25 each, and about 2,000 are employed on the lakes. They are used in transporting the fish from the receiving ports to the large wholesale markets and for distributing them to the various inland dealers. When emptied, the cars are returned to the shippers.

The foregoing represents the general methods employed in icing fresh fish at the various marketing centers. In addition to these there are special methods of handling certain important varieties of marine products which experience has proven to be of value, such as icing cod, haddock, halibut, mackerel, shad, oysters, etc.

SHIPPING ROOM OF CINCINNATI FISH AND OYSTER COMPANY, CINCINNATI, OHIO.

DRESSING, ICING, AND BOXING FRESH HALIBUT AT GLOUCESTER, MASSACHUSETTS.

ICING COD, HADDOCK, AND BLUEFISH.

During the last thirty years cod and haddock have largely increased the fresh-fish trade. Prior to 1860 haddock was very little esteemed, but at present it is the most important fish in the fresh-fish markets of the New England States and one of the most important in the United States. During 1889 the quantity of fresh haddock received at New England ports aggregated 41,155,481 pounds, and of cod, 30,168,643 pounds, nearly all being the product of the vessel fisheries.

In the fresh cod and haddock fisheries the hold of each vessel is generally fitted up with twelve to fifteen pens, each about 6 or 8 feet long and 4 or 5 feet wide, with capacity for 1 or 2 tons of fish and the necessary ice. When the vessel is making a long trip, from 10 to 20 tons of ice are carried, but during cold weather this quantity is much reduced. When the fish are received on the vessel the men dress them, seizing each fish by grasping it about the eye or some part of the head with the left hand and ripping it down the throat, removing the viscera, which is thrown overboard, while the liver and roes are placed in barrels. The fish are washed in tubs or by pouring buckets of water over them as they lie on the deck, and are then ready for icing in the pens. A layer of block ice is placed at the bottom of each pen, next a layer of fish, backs up, and, sometimes, when the weather is warm, the abdominal cavity of the fish is filled with fine ice. A layer of ice is placed over the fish and about the ends and sides, and successive layers of fish and ice are added with a layer of ice on top of all, the ice being chiseled or planed with a sharp dentated chisel attached to a long handle. The care taken in icing the fish conforms to the probable time that will elapse before the schooner reaches port; when the weather is very cold and the wind favorable for a quick run to market the quantity of ice used is largely reduced or it is even dispensed with altogether.

The method of icing bluefish on the New York market vessels differs little from the process applied to cod and haddock. The vessels carry 15 to 25 tons of ice each in the pens, whence it is removed as the fish are stored. Immediately on landing on the vessel's deck the fish are split from the pectoral fin to the vent, the viscera removed and the stomach cavities washed thoroughly. At the bottom of each pen is placed a layer of block ice, 6 or 8 inches thick, covered with a thin layer of chiseled ice. On this is placed a layer of bluefish, backs upward, and inclined slightly on the side, so that all moisture may run from the stomach cavity. This is succeeded by alternate layers of chiseled ice and bluefish until the pen is nearly full, the whole being covered with a layer of crushed ice.

ICING HALIBUT.

The fresh-halibut industry is one of the most extensive branches of fishery trade depending almost entirely on the use of ice. On the Atlantic coast alone about 10,000,000 pounds of fresh halibut are handled annually, and there is also a considerable trade on the Pacific coast. In the early years of the halibut fishery, on Georges and other neighboring banks, no ice was used, the fish being simply eviscerated and placed in heaps in the hold. Later, in order to prevent a bruised and compressed appearance in those in the lower part of the heap, the fishermen suspended the fish by the tails in the hold, this being practiced as late as 1846 in tight-bottomed vessels.

From 1835 to 1850 well-smacks were employed, and though they were quite popular with New London and Greenport fishermen, they were not generally used on the Massachusetts coast. About 1840 a small quantity of ice was generally carried for icing the fish accidentally killed, and with the development of the trawl fishery the use of ice became general, both on smacks and on the tight-bottom vessels. At first the ice was not placed among the fish, being carried for the purpose of cooling the hold, but about 1846 it became customary to crush it and mix it with the fish.

The New England halibut vessels now usually carry from 15 to 30 tons of ice stored in pens in the hold of the vessel, similar to those used in the haddock fishery, and the present method of handling and icing the halibut is as follows: In dressing, each halibut is grasped by the gills with the left hand, the head raised from the deck, and with quick strokes of the knife the gills are separated from the head and from the napes. The fish is then ripped down the belly, and the gills and viscera are removed with the left hand. A second operator takes the halibut and with his bare right hand removes the ovaries from their cavities and the blood from the backbone, pressing his thumb along each side of the backbone to express the blood therefrom. The fish is then passed to the scrub gang, composed usually of three men. One of these, hooking an iron gaff into the head of the fish and another gaff into one side of the nape, holds the fish up and open, while a second workman, with a hickory or oak broom, scrubs off all loose blood, slime, etc., from the spawn cavities and the backbone. During this process a third man souses water into the fish, completely rinsing it out.

The halibut is next passed into the vessel's hold, which is divided by permanent compartments into 10 or 12 pens or bins, half on either side of the vessel, with an alleyway in the middle. A layer of ice is placed in the bottom of the bin, and on this is placed the halibut in rows or tiers, with heads toward the front and back of the bins and tails overlapping in the middle. The abdominal cavity of each fish is filled with finely chiseled ice and the fish so placed in the bin that the ice will not spill from the cavity. No ice is placed between the fish, as in case of fresh cod and bluefish, because of its tendency to bruise the sides of the halibut. As each bin is filled, slide boards are placed at the front and a quantity of ice is put about the heads of the fish, both in the back and front of the bin, and on top of the fish is a layer 6 to 12 inches deep. The amount used varies, of course, according to the temperature, much more being required during warm weather than when the temperature is low. When packed in this manner, halibut will keep in good condition for three or four weeks.

On arriving in port the halibut are removed from the hold of the vessel to the fish-house and assorted, the "white," "gray," and "seconds" or "poor" halibut being kept separate. The "white" halibut are those having the under side pure white, the "gray" are more or less tinged with gray or drab in the same place, while the "poor" halibut or "seconds" are such as are slightly tainted in the vicinity of the abdominal cavity. The "white" halibut ranges from 3 to 15 cents per pound out of the vessel, the "gray" halibut is generally about two-thirds that allowed for white, and "poor" halibut sells for about 1 cent per pound. The distinction between "white" and "gray" halibut was made first in 1848, and while fishermen receive much less for the latter, little distinction is made in the retail trade between the two, both selling at nearly the same price, and it is impossible to distinguish them separately when cooked. After assortment the fish are weighed and 14 per cent is deducted as the weight of the heads to obtain the basis for settlement with the fishermen. The heads are cut

off and sold to oil and fertilizer factories for about $1 per 100 pounds. The fish are then placed mostly in stout pine boxes containing each about 450 pounds, and also in 100-pound boxes and 200-pound barrels. In case a halibut is too long to go in the box the tail may be cut off; otherwise the tail and fins remain on. As the fish are placed in the box, the abdominal cavities are filled with crushed ice, and in summer time the fish are surrounded with chiseled ice. The cover is nailed down, the box and its contents weighed and shipped to its destination.*

ICE IN FRESH-MACKEREL FISHERY.

It is customary for vessels engaging in the fresh-mackerel fishery, especially in the spring southern fishery, to carry from 5 to 20 tons of ice, according to the size of the vessel and the time of the year. Usually from June 1 to September 30 the fish are gibbed, the gills and viscera being drawn out together through the gill-openings, but during the spring and fall the fish are iced round. The fish are stowed away as soon as practicable after being caught, being packed in bins in the hold of the vessel similar to those in the fresh cod and haddock vessels, except that each bin is divided horizontally by movable platforms into two or three parts or shelves to prevent crushing the lower layers of fish, as would be the case were they the full depth of the haddock bins. A thick layer of ice is placed in the bottom of the bin, and this is followed by alternate layers of fish and fine ice, the topmost layer being of ice.

The extent of icing depends, of course, on the length of time that will probably elapse before the fish are placed on the market. Ice-grinding machines are no longer carried on any fishing vessels, since they take up much room and the ice may be chiseled more quickly than ground. Those mackerel caught when the hold is full or just before leaving the fishing-ground for market are sometimes placed with crushed ice in barrels on the deck of the vessel. Each vessel also carries barrels for salting such fish as are not to be carried to market fresh.

Vessels engaged in the salt-mackerel fishery occasionally take fresh mackerel into port by placing them, after being gibbed, in barrels of water, but this is practiced only to a limited extent.

ICING SHAD.

Few species of fish show greater increase in selling price as the result of careful handling and icing than the shad, yet in the marketing of few valuable species is greater carelessness shown by the average shipper. It frequently happens that the fish immediately from the water are carelessly placed in the shipping boxes or barrels with insufficient ice, much of which is melted in cooling the fish before the package starts on its journey. The package then being not quite full, the contents move from their respective positions in handling, resulting in loosening the scales and bruising the surface of the fish considerably. The shad trade is very large, the quantity marketed annually on the Atlantic coast of the United States approximating 14,000,000 in number, or 52,500,000 pounds, nearly all of which are used fresh.

The following is the best method of handling fresh shad: If practicable the fish-house should be raised 2 or 3 feet above the water or the shore, so that the wind may freely circulate and cool the floor. The fish ought to be handled carefully, bruises

*See the Fishery Industries of the United States, sec. V, vol. 1, pp. 21–22.

being avoided as much as practicable, protected from the heat of the sun, laid on the floor as received from the boats, the heads of each row resting on the tails of each preceding row, and a layer of crushed ice 1 or 2 inches thick spread over the whole. There the fish remain until it is necessary to place them in the shipping packages, which may be boxes or ordinary sugar-barrels. The former are preferred if satisfactory shipping rates are secured, but because of more favorable shipping rates barrels are more frequently employed. A layer of crushed ice is put in the bottom, on which the shad are placed on their backs, with the heads at the ends if boxes are used. This is followed by a layer of fine ice, succeeded by similar layers of fish and ice, with a double quantity of ice at the top, the boxes being covered with boards securely nailed and the barrels with bagging fastened under the top hoop.

ICING OYSTERS.

Ice is very generally employed in preserving and shipping shucked oysters to the retail trade. During cold weather only a small quantity is used, but the ice bill of the oyster-dealers throughout the season is a considerable item. In using ice for this purpose it was formerly considered important to keep it separate from the oysters—generally by having a separate ice chamber in the package or keg containing the oysters. In some packages the chamber occupied one side of the package, or it filled a space entirely surrounding the oysters, but usually the ice was in the central part, the oysters filling the annular space about the chamber. A variety of packages have been invented for this purpose, differing particularly in the manner of affording separate access to the two chambers. Many of these have been patented, and for further description of them reference may be made to the following United States letters patent:

No. of patent.	Date.	In favor of—	No. of patent.	Date.	In favor of—
103551	May 31, 1870	Alfred Booth, Chicago, Ill.	240281	Apr. 19, 1881	Alvin Squires, Hartford, Conn.
111722	Feb. 14, 1871	Do.	250107	Nov. 29, 1881	C. A. Sheridan, Detroit, Mich.
135083	Jan. 21, 1873	L. R. Comstock, Baltimore, Md.	255017	Mar. 14, 1882	C. L. Pond, Buffalo, N. Y.
142703	Sept. 9, 1873	James C. Jones, New York.	265137	Sept. 26, 1882	Do.
158089	Dec. 22, 1874	Do.	300061	June 10, 1884	S. L. Frazer, Toledo, Ohio.
190333	May 1, 1877	Do.	300476	June 17, 1884	O. P. Johnson, Washington, D. C.
199569	Jan. 22, 1878	James J. Phillips, Norfolk, Va.	374119	Nov. 29, 1887	M. H. Dotson, Baltimore, Md.
209189	Oct. 22, 1878	Frank Pfeiffer, Norfolk, Va.	405488	June 18, 1889	John P. Kuhn, Alton, Ill.
240143	Apr. 12, 1881	O. P. Johnson, Cambridge, Md.	438391	Oct. 14, 1890	John T. Store, Baltimore, Md.

A refrigerator oyster-shipping package, patented by a leading oyster-dealer, and formerly used to a considerable extent, is constructed as follows:

A sheet-metal can is employed with a capacity of 20 gallons, flanged edges projecting from the top ends of the can. In the center of the can, extending from top to bottom, is formed a rectangular ice chamber which is opened at the top and has four sides exposed within the body and to the contents of the can. This chamber is closed by means of a wooden cover of suitable dimensions to fit snugly within the flanged edges of the end of the can over the opening into the ice chamber and against the screw-cap, and projecting a little beyond the ends of the flanges, and secured thereto so as to be easily removed. At the opposite end of the can a similar wooden cover or guard is fastened, these covers also serving to protect the ends of the can from injury during transportation. The can is placed in a wooden case or enveloped with wooden covering to protect it during shipment and to more effectually exclude heat from the contents of the can. The oysters are placed in the annular space about the ice chamber, this space holding about 15 gallons; the ice chamber is filled with ice and the covers fastened, when it is ready for transportation. (See Letters Patent No. 111722, dated February 14, 1871.)

The use of these intricate forms of shipping packages was abandoned several years ago, and at present the trade throughout the country uses ordinary package-tubs in various sizes, ranging in capacity from 1 to 10 gallons, the tubs being returned to the wholesalers as soon as the oysters are sold. The covers are loosely fitted on top and fastened by tacking small tin clasps to the tops and sides. Handles are provided at the sides of the tubs for convenience in transfer. The oysters are chilled with chunks of ice before being packed for shipment, and when placed in the shipping-tub a block of suitable size to last through the journey is added. During cold weather ice is sometimes omitted, but it is poor economy to stint in its use. The size of the tubs should be adapted to the quantity of oysters shipped, so that each tub may be quite full, to prevent the agitation or slushing of the oysters. In order to prevent the cutting and bruising of the oysters by the block of ice while the tub is being handled and in transit, a flexible pocket of cotton cloth, muslin, or other cheap texture is occasionally used by some shippers, the block of ice, of a size suited to the oyster package, being placed in this pocket and the whole suspended rigidly from the sides of the tub.*

The oyster tubs are generally shipped in refrigerator cars, these leaving the principal oyster markets regularly during certain days of the week. When the weather is very cold, the refrigerator car is a protection against the oysters freezing. Fat oysters will not freeze as quickly as thin ones, as the latter contain more water. But freezing does not greatly injure shucked oysters when mixed with their own liquor, provided they are consumed soon after thawing.

In many localities, especially along the Gulf coast and through the West, a practice prevails of shipping opened oysters in hermetically sealed square cans, containing from 25 to 100 oysters, these cans being then placed in boxes with the tops and sometimes the sides in contact with crushed ice. This method is not so general as it was several years ago, on account of the extra expense incurred, and the condition of the oysters shipped in bulk is generally about as satisfactory.

REFRIGERATOR CARS.

The large inland trade in fresh fish and the liability of frozen fish to rapid decay when subjected to a higher temperature have resulted in an extensive use of refrigerator cars for transportation purposes. The refrigerator car is little more than 30 years old, the first American patent being issued on November 26, 1867, to J. B. Sutherland. His claim covered a car with double walls, roof, and floor, with ice chests at each extremity, closed by hanging flaps, and having spaces so arranged as to produce a constant circulation of air in the car. The air was admitted at the top of the car and passed down through the ice chamber, and entered the room near the bottom at a low temperature. In March, 1868, George K. Wood, of Morristown, N. J., brought out a car with a plurality of metallic chambers for the respective reception of way and through freight, with an ice chamber above; while the car of A. L. McCrea, of Chicago (March, 1869), had interior movable sections. Numerous other patents followed in quick succession, scarcely any of which embody the features of those now in extensive use.

The following description of one of the most practical of the forms of refrigerator car in general use at present gives an idea of their construction:

> The ice and salt receptacles are four galvanized-iron cans strongly jacketed at each end of the car, extending from the roof to within 6 or 8 inches of the floor, and under them is a pan to catch the drip, the overflow escaping through an air-tight trap. The walls, roof, and bottom are 7 inches

* See Letters Patent No. 438391, dated October 14, 1890.

in thickness, made with a dead-air space and three 1-inch layers of hair felt, the joints of the doors being padded. No air enters the car when closed, and there is no provision for circulation of air within the cooling chamber. Each car carries about 6,000 pounds of crushed ice mixed with about 600 pounds of fine rock salt, which is entered at the top and tapped down in the cans, after which the covers are put on and the roof holes closed. In eight or ten hours the receiving room of the car has become chilled, when additional ice and salt is added and the car is ready for the freight.

The longest transportation of fresh fish in this country is the sending of salmon from Columbia River to the Atlantic coast, requiring five or six days. The methods are thus described by Messrs. Seufert Bros. Co., of The Dalles, Oregon:

We ship all our fresh salmon by express for New York and all points east in boxes 44 inches long, 20 inches wide, and 12 inches deep. We put in each box 175 pounds of fish undressed, or just as they leave the water, and 75 pounds of crushed ice in each box. The express company refills these boxes daily at certain icing stations along the line, and makes no extra charge on these icings, that being all included in the express charge of 8½ cents per pound on the net weight of the fish to Chicago, or 10½ cents to New York, or 7½ cents to the river or Union depot, Council Bluffs or St. Paul, Minn. In shipping carload lots we put 150 pounds in each box, fill the box with ice, and load 12 tons of fish in a car. We use about 8 tons of ice, and these cars are not opened or re-iced until they reach New York, by passenger train service to Chicago and fast freight from Chicago to New York over Erie Railway, on Wells Fargo express trains, 30 hours' time. These cars reach New York in 5½ days from this river.

The shipment of fresh salmon in carload lots across the continent began in 1884, during which year eight carloads of fresh salmon were sent east, all arriving in good condition. On account of the high rate for freight service in refrigerator cars the profits were so small that further shipments were postponed until a reduction in rates was made in 1890.

FREEZING FISH IN THE OPEN AIR.

In cold countries the freezing of fish in the open air during cold weather is a natural and doubtless one of the oldest forms of preservation. In the northern portions of Europe and America fish are frequently preserved in this manner. Prior to the use of ice in the United States it was not unusual during the winter and early spring for dealers to take fish frozen by natural cold from Boston or New York 200 or 300 miles inland. But the uncertainty of depending on continued cold weather, and the advent of the use of ice and quick transportation, have resulted in an abandonment of that trade.

There is yet a very extensive trade in frozen smelt during the winter, especially in December and January. These fish are frozen in Maine and the British Provinces, boxed and shipped by steamer or rail to Boston or New York, whence they are supplied to the retail trade. During the season of 1897, 82,306 boxes, each holding an average of 25 pounds of smelt, were received in Boston. Most of these come from the British Provinces, being admitted free of duty, and they are sold from 2 to 8 cents per pound, averaging perhaps 4 cents per pound, wholesale.

FROZEN-HERRING INDUSTRY.

The most important industry depending on open-air refrigeration is the freezing of herring on the Newfoundland and New Brunswick coasts for the United States markets. This is scarcely more complicated than the usual method of packing in crushed ice, and not by any means so intricate as the process of mechanical or chemical refrigeration now employed in the large marketing centers of the United States. It

originated during the winter of 1854–55, the immediate object being to supply the vessels engaged in the Georges Bank cod fishery with bait. At present those vessels, as well as those employed in the bluefish fishery, depend almost entirely on this form of bait during the winter and early spring, and in addition large quantities of frozen herring are used for food.

The process of freezing is as follows: When the vessel has been moored in some cove convenient to the fishing-ground, the ballast is thrown overboard, the hold sheathed up around the sides with spruce boughs, and a platform built in the bottom of the hold several inches above the keelson. A bulkhead 6 inches thick, with the space in the middle filled with sawdust, is placed across the forward part of the hold to separate it from the forecastle. Sometimes the fish are frozen ashore by the natives, a clear, gravelly beach above high-water mark or a surface of crushed snow and ice being chosen. But usually the freezing is done on a large scaffolding on the deck of the vessel. This scaffolding is generally about 100 feet long by 25 feet wide and is built of rough boards, most of which are purchased at Nova Scotia points on the way to Newfoundland, they being obtainable much cheaper there than in Gloucester. The quantity of fish placed on the scaffold varies according to the weather.

When the temperature is little below the freezing point, the fish must be spread very thin, in order that those underneath may be thoroughly frozen; but, with a lower temperature, the fish can be heaped together to the depth of a foot or more, though in such cases it is necessary to turn them every few hours. A constant watch must be kept to guard against loss from a sudden rise in temperature or a storm of rain or snow. The watch usually turns the fish with a wooden shovel or stirs them with his feet every few hours, and during a snow storm it becomes necessary to work constantly among them to keep them from being covered up. Should the weather become so warm that the fish would be thawed by exposure, it is necessary to place them in piles and cover them with canvas or other material, again exposing them when the temperature has fallen sufficiently. The usual method of ascertaining whether a herring is sufficiently frozen is by breaking. If the fish bends at all it is not thoroughly frozen; but if it breaks short, like a dry stick, it is ready to be stowed in bulk.

The herring are roughly shoveled in the vessel, the hold, and sometimes even the cabin, being filled, the crew in the latter case living in the forecastle on the homeward passage. Formerly the fish were packed in snow, or a considerable quantity of snow was placed around the sides of the hold and the fish heaped together in the middle; but for many years this practice has been wholly abandoned, and it is found that the fish will keep equally well without the use of snow.

This trade at present averages about 25,000,000 herring annually, with a valuation of $300,000. About one-third are used for bait by the Gloucester fishermen, and those remaining are sold for food. The market value varied for many years from 75 cents to $3 per 100 fish wholesale, while the retail price was about double those figures. During the past three years the fish have been sold by weight, two scales being on the vessel, one at the main hatch and the other at the aft hatch; the average wholesale price during those years has been from $1.25 to $2.50 per 100 pounds.

Frozen herring form cheap and wholesome food at a season when other fresh fish are obtained with difficulty and only at a high price. They possess a great advantage over ordinary fresh fish in that they can be packed in barrels without ice and shipped to a considerable distance without danger of loss. With the exception of those sold

in Gloucester for bait, nearly all the frozen herring are carried directly to Boston and New York, and two or three cargoes are carried to Philadelphia each season. At these places they are sold locally and packed in barrels for distribution, and sent as far south as Washington, and as far west as the Mississippi River.* After reaching their destination, the great bulk are sold fresh, but some are pickled by the dealers, while others are cured as bloaters or hard herring. After being frozen, herring are not especially desirable for either of these purposes, as they become soft and the flesh is rather dark and unattractive in color

ARTIFICIAL FREEZING AND COLD STORAGE.

The artificial freezing of fish and other food products with their subsequent retention in cold storage is one of the most recent methods of preservation, originating about thirty-five years ago; and while it has acquired considerable importance in certain localities, its practical value is scarcely appreciated by the general public. It is applied in the various marketing centers of the United States and to some extent in the countries of Europe and South America. Its greatest development and most extensive application in the fisheries exists along the Great Lakes in freezing whitefish, trout, herring, pike, etc., about 3,500 tons of which are frozen each year. On the Atlantic coast of the United States it is used in preserving bluefish, squeteague, mackerel, smelt, sturgeon, herring, etc., the trade in these frozen fish "tailing on" or immediately following the season for fresh or green fish. On the Pacific coast large quantities of salmon and sturgeon are frozen and held in cold storage until shipped, the trade extending to all parts of America and northern Europe. At various points throughout the interior of the country there are cold-storage houses where fishery products are held awaiting demand from consumers. In Europe there is comparatively little freezing of fish, although the process is applied very extensively to preserving beef, mutton, and other meat products, and the markets of Hamburg and other continental cities receive annually several million pounds of frozen salmon from the Pacific coast. In England large fish-freezers were erected several years ago at Grimsby and Hull, but did not prove successful and were finally dismantled.

By the use of ice alone during warm weather the temperature of fish can never be kept below 32° F. While this low temperature retards decomposition, the fish acquire a musty taste and loss of flavor and eventually spoil. To entirely prevent decomposition the fish must be frozen immediately after capture and then kept at a temperature of several degrees below freezing. The belief held by some persons that freezing destroys the flavor of fish is not well founded, the result depending more on its condition when the cold is applied and the manner of such application than upon the effect of the low temperature. Fish decreases less in value from freezing than meat does, but it is especially subject to two difficulties from which frozen meat is free; first, the eye dries up and loses its shining appearance after a very long exposure to cold, and second, the skin, being less elastic than the texture of the fish, gets hard and becomes somewhat loose on the flesh. Frozen fish is not less wholesome than fish not so preserved. The chemical constituents are identical, except that the latter may contain more water, but the water derived from ingested fish has no greater food value than water taken as such. The principal objection to this form of preservation is the tendency to freeze fish in which decomposition has already set in, and the prosperity of

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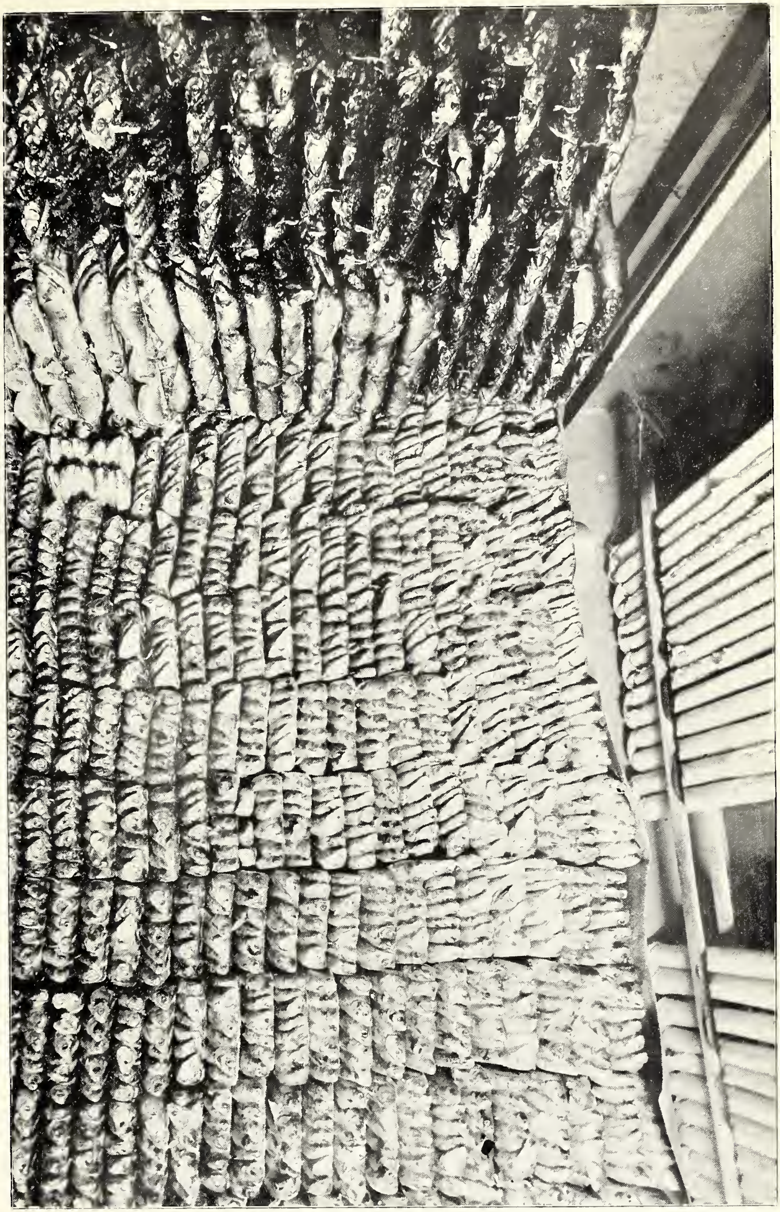
* See Fishery Industries of the United States, sec. v, vol. 1, p. 451-456.



STORAGE ROOM OF AMMONIA REFRIGERATING PLANT AT CINCINNATI, CONTAINING LAKE HERRING.

the frozen-fish business requires that any attempt to freeze fish already slightly tainted should be discountenanced. When properly frozen and held for a reasonable period, the natural flavor of fish is not seriously affected and the market value approximates that of fish freshly caught. The process is of very great value to the fishermen supplying the fresh-fish trade, since it prevents a glut on the market, and it is also of benefit to the consumer in enabling him to obtain almost any variety of fish in an approximately fresh condition throughout the year.

DEVELOPMENT OF COLD STORAGE.

The first practical device for the freezing and subsequent cold storage of fish was invented by Enoch Piper, of Camden, Me., to whom a patent* was issued in 1861. His process was based on the well-known fact that a composition of ice and salt produces a much lower temperature than ice alone, this knowledge having been applied for an indefinite period in freezing ice creams, etc.

The following is a description of Piper's apparatus and its application:

> The fish were placed on a rack, in a box or room having double sides filled with charcoal or other nonconducting material. Metallic pans containing ice and salt were set over the fish and the whole inclosed. The temperature in the room would soon fall to several degrees below the freezing point of water, and in about 24 hours (the mixture being changed once in 12 hours) the fish would be thoroughly frozen. The fish were then covered with a coating of ice by immersing them a few times in ice-cold water, or by applying the water with a brush, forming a coating about one-eighth of an inch in thickness. After the coating of ice was formed the fish were sometimes wrapped in cloth and a second coating of ice applied. In some instances they were covered with a material somewhat like gutta percha, concerning which much secrecy was exercised. The fish were then packed closely in another room, well insulated against the entrance of warmth, by means of double walls filled with some nonconducting material. Fixed perpendicularly in the second room were a number of metallic tubes, several inches in diameter, filled with a mixture of ice and salt to keep the temperature below the freezing point.

The process was also patented in the Dominion of Canada, and a plant was established near Bathurst, New Brunswick, in 1865, the output consisting almost entirely of salmon, a large proportion of which were imported into the United States. In order to hold the frozen fish in New York while awaiting a market, Piper constructed a storage room in a shop on Beekman street, that being the first cold-storage room for fish in the United States. The walls of the room were well insulated, and around the sides were two rows of zinc cylinders, 10 inches in diameter at the top and decreasing in size toward the bottom, connecting at the lower end with a drainage pipe. The cylinders were filled with a mixture of ice and salt, which was renewed whenever necessary. Whatever may have been the imperfections in his process of freezing, the system of storage was quite satisfactory and differs little from that in use at the present time. Piper refused to sell rights to others for the use of his process, and after maintaining a monopoly of the business for three or four years his exclusive right to it was successfully contested by other fish-dealers in New York, who applied it to storing other fish besides salmon.

The principal objection to Piper's process is that the fish are not in contact with the freezing mixture during the operation of freezing, and, consequently, too much time is required for them to become thoroughly frozen. Several devices have been used for overcoming this objection, among which are covering the fish with thin sheet rubber or other waterproof material, and packing them in the mixture of ice and salt.

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* No. 31736, dated March 19, 1861.

The greatest improvement, and the one used almost exclusively when ice and salt form the freezing agency, originated in 1868 with Mr. William Davis, of Detroit, Mich.,* the description being as follows:

Two thin sheet-metal pans, or a box in two parts, are made one to slide over the other, the object being to place the fish in one pan, slide the other pan vertically over it, and the box is then placed in direct contact with the freezing mixture. By having the box constructed in this manner, it is capable of being expanded or contracted to accommodate the size of whatever may be placed therein, and the top and bottom always be in contact with the articles to be frozen. After the fish are inclosed in the pans, the latter are placed in alternate layers with layers of the freezing mixture between and about them. When the fish are thoroughly frozen they are removed from the freezing pans and placed in a cold-storage chamber in which the temperature is kept 12 or 14 degrees below the freezing point.

Another arrangement for bringing the fish in contact with the ice was devised and patented by a fish-dealer of Toledo, Ohio,† as follows:

A chest is so constructed that cells or compartments of various sizes may be formed in it for the reception of articles to be frozen, this being accomplished by having the walls of each compartment movable and each separated from the other by blocks of sufficient size to closely contain the articles placed therein, usually from 2 to 6 inches, and the freezing being effected by filling the spaces between the cell walls with salt and crushed ice. The sides of the cells or compartments are made of thin metallic plates, so that the upper end of each pair may be brought together, forming a closed compartment, to prevent the entrance of the refrigerating mixture into the fish chambers while filling the salt and ice compartments. To freeze a quantity of fish by this method, they are placed in the open cells or compartments, head downward, as is most convenient. When each cell is full, the top edges of the sides are brought together and held in that position by clamps. The spaces between the cells, varying from 2 to 4 inches across, are then filled with the freezing mixture and the cover of the chest shut down. The cold produced passes through the wall separating the mixture from the fish and quickly freezes the latter. Provision is made for permitting the water formed by the melting ice to flow in grooves to suitable outlets, the bottom pieces of the cells keeping the fish dry. When the fish are frozen, the cover of the chest is raised, the contents removed, and the fish transferred to the storage freezer.

This method of freezing was used only a few years, the pan process being found much more practicable.

With a view to bringing the fish more closely in contact with the freezing mixture, some dealers at first used thin sheet-rubber bags, or other waterproof sacks, in which the individual fish were placed and then surrounded by the salt and ice, thus exposing the entire surface of the fish, resulting in much more rapid freezing. When the fish were frozen the sacks were removed and were dipped in water, which thawed them sufficiently to permit the fish to be withdrawn. This method was abandoned after a year or two.

To facilitate the shipment of frozen fish in barrels, Messrs D. W. & S. H. Davis, of Detroit, Mich., introduced‡ a process by which the fish are frozen in circular pans of varying sizes suited to the measurements of the barrels. After being frozen, the contents of each pan are removed entire and placed in appropriate position in the barrel, and the barrel headed and placed in cold storage.

In 1877 C. W. Gauthier patented § a modification of the preceding method, using thin pliable partitions in the circular pans for separating each fish from its neighbor, so that the individual fish in each pan may be packed in the barrel separately. None of the last four processes has ever been used to any considerable extent.

* Letters patent No. 85913, January 19, 1869.
† Letters patent No. 109820, December 6, 1870.
‡ Letters patent No. 165596, dated April 6, 1875.
§ Letters patent No. 187122, dated February 6, 1877.

As the trade developed, the size of the storage rooms was increased and improvements were adopted in the arrangement and form of the ice-and-salt receptacles and in the method of handling the fish. But the freezing with pans immersed in ice and salt, as in the Davis process, and the subsequent storing of them in the manner used by Piper, continued without any great modification until the introduction of ammonia freezers into the fishery trade in 1892. At that time ice-and-salt freezers and storage rooms existed at nearly all the fishing ports on the Great Lakes; eight or ten small ones were in New York City, and several were in use on the New England coast. Some of those on the Great Lakes were very large, with storage capacity of 700 or 800 tons or more, and the aggregate storage capacity of all in the country approximated 8,000 tons. Ammonia cold-storage houses had been established at various places along the coast and in the interior during the ten or fifteen years preceding, and in these some frozen fish had been stored. But the first ammonia establishment for freezing fish exclusively was established at Sandusky, Ohio, in 1892. The method of freezing differs from the former process in that the pans of fish are placed on and between tiers of pipes carrying cold brine or ammonia instead of being immersed in ice and salt. In the storage rooms less difference exists, coils of brine pipes taking the place of the ice-and-salt receptacles, the blocks of fish being removed from the pans and stored as in the older process.

DESCRIPTION OF ICE-AND-SALT FREEZERS.

The outfit of an ice-and-salt freezer consists principally of temporary stalls or bins where the fish are frozen, and insulated rooms where the frozen fish are stored at a low temperature. In addition to these there are ice-houses, salt-bins, freezing-pans, and the various implements for the convenient prosecution of the business. The freezing bins are usually temporary structures within the fish-house, and are generally without insulation. The wall of the fish-house may form the back, while loose boards are fitted in to form the sides and front as the bin is filled, in the manner hereafter described. A better way is to build the bins with sides and back 4 or 5 inches thick, filled with some nonconductor, with double or matched floor and with movable front boards.

The storage rooms are commonly arranged in a series side by side and separated from each other by well-insulated partitions, the capacity of the rooms ranging from 25 to 200 tons each. The outer walls of these rooms, as well as the floors and ceilings, are well insulated, made usually of heavy matched boards, with interior packing of some nonconductor of heat. Among the latter may be mentioned planing-mill shavings, sawdust, pulverized charcoal, chopped straw, slagwool, etc. Most of the walls are 16 or 18 inches thick, filled with planing-mill shavings or sawdust, and in some freezers the damaging effect of rats is obviated by placing linings of cement between the shavings and the board walls. Most of these loose materials have their economic drawbacks, chiefly because of their strong hygroscopic tendency, the material losing its insulating power and decaying, this decay also attacking the wood of the walls. Because of this, many of the storage rooms recently constructed are insulated by having the walls made up of a combination of mineral wool, insulating paper, air spaces, and inch boards.

The sides, and in some cases the ends, of the room are lined with the ice-and-salt receivers, consisting of galvanized sheet-iron tanks, 8 or 10 inches wide at the top, narrowing to 3 or 4 inches at the bottom, and placed about 4 inches from the wall in order to expose their entire surface to the air in the room. These tanks open at the

top, which extends above the ceiling so that they may be filled without opening the storage room. At the bottom is usually a galvanized-iron slanting gutter, into which the water resulting from the melting ice flows, whence it is conducted through the floor of the room by a short pipe, protected from the entrance of air at its lower end by a small drop cup, into which the brine falls and runs over at the top. In some fish-houses this brine, which is otherwise wasted, runs into receiving tanks, where it is stored and used as required in pickling fish. The ice-and-salt tanks must be cleaned from time to time in order to rid them of dirt and sawdust. Their capacity should be in proportion to the size of the room and the excellence of the insulation secured, and they should be large enough to render it unnecessary to fill them oftener than once a day, even in the warmest weather.

The appliances used in the ice-and-salt freezers are described at length in the account of the processes of freezing and storage (see pp. 377–384).

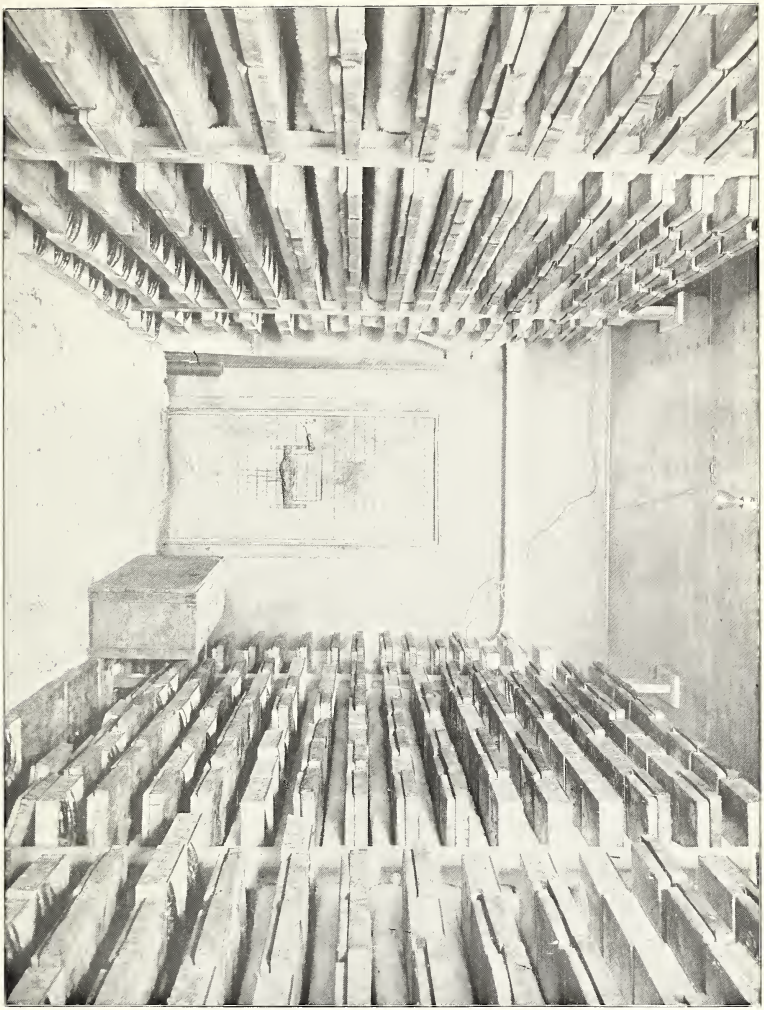
While crushed ice and common salt are generally employed as a freezing mixture, numerous other compounds are available. The following compilation gives a number of mixtures that may be employed in refrigeration, the initial point in the case of crushed ice or snow being 32°, and in the other mixtures 50° F. Most of these have as yet been employed only in laboratory practice and for certain special purposes, only a few of them having been applied commercially on a large scale. These formulæ are obtained mostly from Leask's Refrigerating Machinery and its Management, published in London in 1895.

Composition.	Parts.	Minimum temperature.	Composition.	Parts.	Minimum temperature.
		° F.			° F.
Crushed ice or snow Sodium chloride	2 1	− 5	Sodium sulphate Hydrochloric acid	8 9	− 0
Crushed ice or snow Sodium chloride Ammonium chloride	5 2 1	−12	Sodium sulphate Ammonium nitrate Nitric acid (diluted)	6 5 4	−40
Crushed ice or snow Sodium chloride Ammonium chloride Potassium nitrate	24 10 5 5	−18	Sodium phosphate Nitric acid (diluted)	9 4	−12
			Snow Sulphuric acid (diluted)	3 2	−23
Crushed ice or snow Sodium chloride Ammonium nitrate	12 5 5	−25	Snow Hydrochloric acid	8 5	−27
Ammonium chloride Potassium nitrate Water	5 5 16	−10	Snow Nitric acid (diluted)	7 4	−30
			Snow Calcium chloride, crystallized	4 3	−50
Sodium sulphate Sulphuric acid (diluted)	5 4	− 3	Snow Potash	3 4	−51

DESCRIPTION OF MECHANICAL FREEZERS.

It is scarcely within the scope of the present paper to enter into a comprehensive description of the numerous systems of mechanical freezers. They are all based on the principle that a liquid passing into a gaseous state, or converted into a vapor, carries away a definite amount of heat from the objects by which it is surrounded.

The compression system is in most general use, and consists of three operations following each other in rotation, and which are practically the same in all refrigerating machines. By means of a large compression pump, anhydrous ammonia, which is the gas usually employed, is compressed to a pressure varying from 125 to 175 pounds to the square inch. During this operation heat is developed according to the amount



FREEZING ROOM OF AMMONIA PLANT AT CINCINNATI, OHIO (CINCINNATI FISH AND OYSTER COMPANY), SHOWING COILS OF CIRCULATING PIPES, FISH PANS, ETC.

of the pressure exerted upon the gas or to the relative volume to which it is reduced, and this heat is withdrawn from the compressed gas by forcing it through coils of pipe in contact with cold water, the heat being transferred to the water. The gas is now ready to assume a liquid state, and in so doing transfers additional heat to the water surrounding the pipes. The liquid gas thus obtained is allowed to enter coils of circulating pipe at a pressure much lower than that required for retaining the gas in a liquid state, whereupon it reexpands and extracts from the pipes and the substances surrounding them a quantity of heat equal to that which was previously given up by the gas during the period of condensation and liquefaction. The gas is then drawn from the expansion coils by the pumps at a pressure of 10 to 15 pounds above that of the atmosphere, and is again compressed in the condensing coils at a pressure of 125 to 175 pounds to the square inch, and the same cycle of operations is repeated. Various modifications of the above, as well as auxiliary processes, have been introduced, but the principles are the same in all compression machines, the differences being in their application.

The absorption system, which is comparatively little used at present, is based on the fact that many vapors of low boiling point are readily absorbed by water, but can be separated again by the application of heat to the mixed liquid; and the machinery in an absorption system differs from that in a compression plant principally in the substitution of an absorber for the condenser and in applying heat to the ammonia water to drive off the anhydrous ammonia at a high pressure.

Formerly, in order to avoid danger from leakage of gas through the circulating pipes carrying the cold ammonia, those pipes were not passed through the freezing and storage chambers, but were stored in a large tank surrounded by some liquid whose freezing point is very low, such as salt brine, or, when lower temperature is desired, a solution of chloride of calcium, and this cooled liquid is pumped through pipes circulating in the freezing and storage rooms. The improvements in the manufacture of freezing machinery have resulted in the making of much tighter pipes, so that at present in many freezers the ammonia coils pass directly through the freezing rooms, and in some instances they also pass through the storage rooms, but brine or chloride of calcium circulation is yet preferred for the storage rooms.

In the mechanical freezing-houses there is a machinery room containing the boilers, compression pumps or absorption tank, according to the system employed, brine pump, etc. Apart from these and within well-insulated walls are the cold rooms, of which there are two kinds—one for the freezing of fish and the other for their storage after being frozen, the capacity of the latter being usually much greater than that of the former. In the freezing-room the circulating pipes containing the cooling material are ½ inch to 2 inches in diameter and arranged in shelves or nests with horizontal layers 4 or 5 inches, and sometimes 10 inches, apart, ranging from the floor to the ceiling, the entire room being occupied with these nests, except sufficient space for moving about. These pipes are sometimes made in separate coils, so that if desired the brine may be circulated through only a portion of the pipes, and there is generally a vertical row of pipes on each side of the freezing-room. The temperature depends, of course, on the quantity of green fish and the progress of the freezing process, but with direct circulation, or using brine made of chloride of calcium as the circulatory medium, a temperature of —10° F., or even less, is obtainable. In this room the green fish are frozen, and then removed to the storage rooms.

The storage rooms are constructed similarly to the storage rooms in ice-and-salt freezing-houses, the only difference being that circulating pipes are substituted for the ice-and-salt receptacles. The pipes in the storage rooms are usually larger, but are not so numerous as in the freezing-room. They are arranged at the ceiling, and sometimes about the upper sides also.

The freezing and storage rooms have well-insulated walls, ceiling, and floors similar to the storage rooms using ice and salt as a freezing agency. The walls are sometimes 16 or 18 inches thick, filled with sawdust or planer shavings; but usually they are made up of successive layers of boards, paper, mineral wool, and air space. In one of the most recently constructed freezing establishments, that of the Cincinnati Oyster and Fish Company, the walls are constructed as follows: Seven-eighth-inch boards, insulating paper, $\frac{7}{8}$-inch boards, 2-inch air space, $\frac{7}{8}$-inch boards, two sheets of insulating paper, $\frac{7}{8}$-inch boards, 4 inches of mineral wool, $\frac{7}{8}$-inch boards, insulating paper, and $\frac{7}{8}$-inch beaded boards. In the same establishment the ceiling is insulated by $\frac{7}{8}$-inch boards nailed against the joists, two sheets of insulating paper, $\frac{7}{8}$-inch boards, 2 inches of mineral wool, $\frac{7}{8}$-inch boards, insulating paper, and $\frac{7}{8}$-inch boards. On top of the ceiling and between the joists there are 3 inches of mineral wool, $\frac{7}{8}$-inch boards, insulating paper, and $\frac{7}{8}$-inch boards. The floor is insulated by nailing $\frac{7}{8}$ by 3-inch strips between the joists and close to the bottom, on top of which are $\frac{7}{8}$-inch boards, insulating paper, and $\frac{7}{8}$-inch boards, the whole being pitched throughout so as to make it perfectly air-tight. Then come 2 inches of air space, $\frac{7}{8}$-inch boards, insulating paper, $\frac{7}{8}$-inch boards, 4 inches of mineral wool, $\frac{7}{8}$-inch boards, insulating paper, $\frac{7}{8}$-inch boards, 3 inches of concrete, and $1\frac{1}{2}$ inches of cement. Resting on the cement floor are $\frac{7}{8}$ by 3-inch oak racks, to permit a free circulation of air under the fish stored in the room.

In 1896 there was erected at Goble, Oregon, a freezing and cold-storage plant differing from any other in the United States, in that cold air is used as the freezing medium. There are similar plants at Montreal and Quebec, and there are several used in Great Britain and Australia for refrigerating beef and mutton.

The following is a description of the Goble establishment:

The building is 100 feet long by 52 feet wide, exclusive of the boiler and engine rooms, which are under another roof adjacent to the main structure. The first floor is well insulated and divided into 8 storage compartments insulated from each other, the dimensions of which are 40 feet in length, 10 feet in width, and 10 feet in height, the floor space within each being occupied by two parallel car tracks with an alleyway between. The floors of these rooms consist of 16 inches of sawdust, 3 pieces of $\frac{3}{4}$-inch hard felt and 5 air spaces, floored over with 1-inch plank; and the walls have two thicknesses of felt and 4 air spaces. The remaining portion of the width of the building, 8 feet on the inside, is occupied by a corridor, in which is a car track with suitable turntables leading to each track in the storage rooms; and the remaining 9 feet net in the length of the building is taken up by an elevator, stairway, and tool room. On the fourth floor there is a tank, 22 feet long and 6 feet wide, filled with brine cooled by ammonia circulation. In this tank there are 5 disks, 4 inches in diameter, revolving on axles running across the tank. The air from the freezing and cold-storage rooms is collected and forced over the revolving disks as the brine drops off, and is then returned by other channels to the freezing and storage rooms.

When the fish, consisting principally of salmon, are received at the dock, they are washed, wiped dry, and placed on cars fitted up with 7 galvanized-iron shelves, 5 feet 4 inches long and 3 feet wide, the capacity of each car approximating 1,000 pounds, and its cost, with the necessary shelves, about $34. When the shelves are filled, the cars are wheeled into the corridor leading to the freezing rooms, and then to the proper compartment, where, still remaining on the cars, they are frozen by the cold air forced over and among them. Each room has capacity for 7 cars on each track, or 14 cars in all,

with 7 tons of fish, giving an aggregate freezing capacity in the 8 rooms of 56 tons at one time. The air introduced in these rooms has a temperature of 5° to 10° F., and is changed every 2 or 3 minutes. Freezing can be accomplished in 12 to 14 hours, but ordinarily from 14 to 24 hours are taken for the operation to be completed, depending somewhat on the size of the fish. After the fish are frozen, the cars are removed to an elevator and run up to the second floor, where the fish are glazed, being dipped in water, and thus covered with a coating of ice about one-sixteenth of an inch thick. This glazing is effected by transferring the fish to racks and then dipping them in a tank 20 feet long by 4 feet wide, partly filled with water at a temperature several degrees below freezing. The fish are then usually wrapped in paper and neatly packed in paper-lined boxes, usually of 250 pounds capacity, ready for shipment, and transferred to storage rooms on the third floor, having a capacity for about 800 tons.

In addition to the machinery above described, there are two 80-horsepower boilers and two 60-horsepower engines, with a fire pump capable of delivering 18,000 gallons of water per hour, an ice plant with capacity of 20 tons a day, and an auxiliary one with capacity of 3 tons daily. The cost of the plant is said to approximate $45,000. The machinery employees number 4, and usually there are 20 men employed in handling the fish.

PROCESS OF FREEZING AND COLD STORAGE.

In freezing fish, as well as in preserving most food products, the superintendent must give close attention to economy of the process as well as to the excellence of the product, and the costliness of the best process sometimes prevents its use. To secure the very best result, the stock to be frozen should be perfectly fresh and free from bruises and blood marks. It improves the appearance, and therefore increases the value, if the fish are graded according to size, but that is rarely done. All kinds of fish keep and look best when frozen just as they come from the water, with heads on and entrails in, and it is better that the fish be not eviscerated before freezing, except in case of very large fish, such as sturgeon. But since the freezers receive the surplus from the fresh-fish trade, many have been already split and dressed. Generally fish that are frozen with heads off and viscera removed are not strictly fresh; but this rule has many exceptions.

Whether round or eviscerated, the fish are first washed by dumping them into a wash box or trough containing fresh cold water, which is frequently renewed, and stirring them about with an oar-shaped paddle or cloth swab to remove the slime, blood, etc. Some freezers consider it inadvisable to wash flatfish, because of their being too thin. From the wash box the fish are removed by hand and placed in the pans, or, better, they are removed with a dip net and deposited in trays situated on a pan-filling bench. The bench in use in most of the freezing-houses of this country is 12 or 15 feet in length and about 2 feet wide, and at intervals of about 3 feet or so there are square trays 3 or 4 inches deep, with lattice bottoms for drainage, in which the fish are deposited from the wash tank. On either side of each fish-tray is room for a fish-pan, at which stands an operative engaged in filling pans.

The pans are of various dimensions adapted to the size of the fish usually received. In most houses they are about 26 or 28 inches long by 16 or 18 inches wide and 2 or 3 inches deep, with capacity for about 40 pounds of fish, the material used being generally No. 24 Juniata galvanized iron, with the corners turned down, riveted and soldered. In some houses much smaller pans are used, the smallest observed by the writer being 16 inches long by 8 inches wide. Generally at each corner in the bottom of the pans there is a small round hole for drainage purposes, but some pans are made water-tight. Each kind has its advantages. In the tight pan the water remaining on the fish from the washing-tank accumulates in the bottom and

adds so much to the material to be frozen, but it also serves to hold the fish together in the frozen block. In some freezing-houses using tight-bottom pans the weight of the ice in the bottom of the frozen block amounts to more than 5 per cent of the total weight. This, of course, increases the weight of the frozen fish when they are sold. An erroneous idea prevails, to some extent, that in using ice and salt for freezing, it is necessary to use tight-bottomed pans to exclude the brine.

The fish are generally placed so as to make a neat and compact package entirely filling the pan, so that the cover will come in contact with the upper surface of the fish. It is desirable to have the backs of the fish at the sides of the pan and the heads at the ends, so as to protect the blocks in handling. It is also desirable, when the size of the fish so admits and a cover is used, that the bellies be placed upward, since that portion has greater tendency to decompose, and, as the cold passes down, this arrangement results in freezing the upper portion of the block first, and also in less compression of the soft portion of the fish by removing the weight therefrom. This practice, however, is not by any means uniform. In case the fish have been split and eviscerated it is advisable to place them slanting on the sides, but with backs up, so as to permit the moisture to run from the stomach cavity, but that is not the general practice. Large fish are necessarily placed on their sides, the fish being curved, if necessary, so as to lie in the pan best. Some freezers place herring and other small fish on their sides two layers deep in the pans, while others place a bottom layer of three transverse rows, the end rows with the heads to the edge of the pan, and a top layer of two transverse rows laid in the two depressions formed between the bottom rows. In case of pike and some other dry fish a small quantity of water is sprinkled over them, since they do not ordinarily retain sufficient moisture to hold together when frozen, as is the case with most other species.

Formerly all pans were provided with covers, as described in Davis's letters patent, and this is necessarily so at present, where ice and salt are used for freezing, the cover being required to separate the freezing materials from the fish. These covers are slightly larger than the pans, so as to slip on easily. The cover best adapted to a pan 26 inches by 14 inches by 2 inches is $26\frac{1}{2}$ inches by $14\frac{1}{2}$ inches by $1\frac{3}{4}$ inches, with the sides slanting toward the base. But in some houses, where circulating brine or ammonia is the freezing medium, the covers are being discarded, resulting in a more rapid freezing of the fish, as the cold does not have to pass through the metallic cover. But in that case the top of the block of fish does not present so smooth an appearance as when the cover is used, for the latter presses the fish down somewhat and unites them more closely, making a firmer package. In order to make a compact block those houses not using covers usually place the small fish bellies down. Only a few freezing houses have discarded the use of the pan covers altogether, and in the more advanced freezers covers are used when the fish can be placed so as to come in contact with the cover, otherwise they are discarded. In many sharp freezers, including the one shown in the illustration opposite page 374, the greater portion of the pans have covers, while the others have none.

As soon as the pans are filled and the covers fitted on they are placed in the sharp freezer. In houses where circulating ammonia or brine is used the sharp freezer consists of a series of coils of small circulating pipes, through which the freezing medium passes, on which the pans of fish are placed, the whole being inclosed in a room of suitable size provided with insulated walls and with doors. Where ice and salt are

PLATE X.

PANS OF FROZEN WHITEFISH, SHOWING ARRANGEMENT OF FISH IN THE PANS.

used, as in most of the freezing-houses, the sharp freezer is usually a stall or bin, open in front and sometimes on the sides, the front and sides being built up with loose boards as the bin is filled.

The arrangement of the ice, salt, and fish-pans in the bin is as follows: The ice, after being passed through a grinder, where it is crushed into small particles, is mixed with salt in the proportion of from 8 to 16 pounds of salt to 100 pounds of ice. The mixing is conveniently done by scattering salt over each shovelful of ice as the ice is shoveled from the grinder to the handbarrow. Many varieties of salt are used, most houses preferring a coarse mined salt because of its cheapness. Others use finer salt because of its coming in close contact with the ice and resulting in a lower degree of cold and the more rapid freezing of the fish, although the salt does not last so long.

The amount of ice and salt required in freezing a given quantity of fish depends principally on the fineness of the materials and the proportion in which they are used, and to a less extent on the insulation of the freezing-bin, the amount of moisture in the atmosphere, and the size of the pans and the manner in which the fish are placed therein. The finer the ice and salt the quicker the freezing and the exhaustion of their strength. A larger proportion of salt also results in quicker freezing. The most economical quantities appear to be about 85 pounds of salt and 1,000 pounds of ice to each 1,000 pounds of fish, although some freezers use much more salt and less ice. Much larger quantities of ice and salt are required during warm weather, and also more is necessary when the atmosphere is moist than when it is dry. Some of the ice and salt generally remains unmelted and this may be used over again in connection with fresh materials, additional salt being mixed with it, and as it is weaker than new ice it should be used mainly at or near the bottom of the pile, the top of the pile taking care of the bottom since the cold descends.

In making the freezing pile an even layer of ice and salt, about 3 or 4 inches deep, is placed at the bottom, on which is laid a tier or layer of pans filled with fish, about 3 inches of ice space intervening between the pans and the sides of the bin. This is followed successively by a layer of ice and salt about 2 or 3 inches deep and a layer of pans, the surface of each layer of ice being made even and smooth by means of a straight edge. Sideboards are placed as the height of the pile requires, and a wide board laid on the pile furnishes a walk for the workmen in placing the freezing mixture and the pans. Some freezers place the pans in double tiers between the layers of ice and salt, and in this case the thickness of the layers of freezing material must be increased. In some freezers a light sprinkling of salt is thrown on top of the pans before the freezing mixture is applied. The pile is built up as high as it is convenient for handling the pans of fish and the ice and salt, which usually does not exceed 6 feet. A double quantity of the freezing material is put on top, and the whole should be covered with wood or canvass to exclude the air. The freezing is usually completed in about 15 or 18 hours, but the fish usually remain one day, when they are ready to be placed in cold storage. On one occasion, at a freezing-house in Cleveland, 2,200 pans of herring, each pan containing about 19 pounds of fish, or a total of 41,800 pounds, were filled and placed in the freezing-bin in 14 hours. Twenty-seven men were required, at a cost of 15 cents per hour each, making the total cost of labor $56.70, or nearly 14 cents per 100 pounds.

In the sharp freezer the fish, being moist, are frozen solidly to each other and to the surfaces of the pans. To remove them from the pan the latter is usually passed

for a moment through cold water, which draws the frost sufficiently from the iron to allow the fish to be removed in a block without breaking apart. In one or two freezing-houses the thawing of the fish from the sides of the pan is omitted, the cover being loosened and the block of fish removed by hitting the pan at the ends and sides. In several houses each pan of fish is dipped for a moment in cold water, when the top is lifted off. This is usually the case in ammonia freezing-houses when the fish are removed from the pans in a cold room where running water would be objectionable.

In most of the houses use is made of a sprinkling trough or tank, $2\frac{1}{2}$ or 3 feet wide and 8 or 10 feet long, with two parallel iron bearings on inclined scantling 6 or 8 inches apart on the inside, on which the pans may slide from one end of the tank to the other. Resting on top and near each end of this trough is a sprinkling box about 36 inches long, 18 inches wide, and 3 inches deep, which usually consists of a box or a block of wood hollowed out from the under surface and with a sheet of metal perforated with many small holes tacked on the bottom. At one end of the box or block is a 1-inch auger-hole, into which the end of a hose may be entered, sending a stream of water into the sprinkling box and through the perforated metal bottom, falling into the trough and overflowing at the lower end.

Some houses substitute a 2-inch pipe with perforated under surface in place of the metal bottom to the box.

The pans of frozen fish are successively placed in the trough under the first sprinkling box, where the water falling through thaws the top sufficiently so that a workman standing at the middle of the trough may remove the cover, and, turning the pan over, he permits it to slide under the second sprinkling box, where the descending stream of water thaws the bottom sufficiently for a workman at the end of the trough to lift it from the block of fish, which remains intact and is removed from the trough and placed on a truck or other conveyance for transfer to the storage room. Three men are required at the trough, one to place the pans under the first sprinkling box, the second to remove the top and turn the pan over and to pass it under the second sprinkling box, and the third to remove the bottom of the pan from the fish and place the block of fish on the carrying truck. In order to avoid thawing the surface of the fish, the water used must be cold and the pans are placed in the trough rapidly, taking but a few moments for the removal of the blocks of fish at the other end. In removing the fish from the pans 8 men are usually required—2 to remove the pans from the sharp freezer and carry them to the sprinkler, 3 at the sprinkler, 1 passing the truck to storage room, 1 handling the blocks of fish in the storage room, and 1 placing them in piles. To sprinkle, unpan, and store 40,000 pounds of frozen fish requires such a force about $3\frac{1}{2}$ hours, and the cost of labor approximates $4.20.

In passing through the trough considerable moisture adheres to the fish, which is frozen by the surplus cold, forming a coating of ice about $\frac{1}{50}$ inch thick, entirely surrounding the irregular block of fish. The process of freezing dries the fish to some extent, the loss in weight amounting to about 2 per cent, but the ice coating placed on them adds about 4 per cent to the weight. Some freezing-houses, in order to make the coating of ice thicker, pass the block of fish, on its removal from the sprinkling trough, through a second trough nearly filled with ice-cold water, which has suspended in it a long box with perforated bottom filled with crushed ice. The blocks of fish pass through a channel in the trough underneath the ice-box, coming out at the other end with a coating of ice $\frac{1}{32}$ inch or more in thickness. In houses where sprinkling

STORAGE ROOM OF AMMONIA REFRIGERATING PLANT, CONTAINING PIKE, HERRING, CARP, ETC.

boxes are not used the fish are dipped by hand in a tank of water after removal from the pans. In some houses the frozen blocks of fish after removal from the pans are dipped, then cross-piled in the cold-storage rooms, and on the following day, or even the second day after, are again dipped in cold water in order to form a thicker coating.

After the blocks of fish are coated with ice they are passed to the cold-storage room, where they are ranged in neat piles, the blocks being placed vertically in some houses, but more frequently they are ranged horizontally in piles extending from the floor nearly to the ceiling. Strips 2 or 3 inches thick are laid on the floor to keep the fish slightly elevated and allow the cold air to circulate underneath.

Care must be exercised in piling the frozen blocks, lest the piles sag and tumble down. When the room is lofty, to avoid heavy pressure on the lower blocks, a platform or floor is arranged about one-half the height of the ceiling, on which the upper blocks of fish rest. A better way of storing the fish is to pack them in boxes, 3 or 4 blocks to the box, and place these in the storage room. While placing the fish in storage, care must be taken to avoid raising the temperature of the room by the admission of warm air. This is usually accomplished by keeping the door closed as much as possible and in some cases by arranging a woolen flap over the entrance to prevent the admission of a current of air, or by having in the door to the storage room an opening just large enough to permit the passage of the packages of fish.

The quantity of ice and salt required in the establishments which use those materials in the storage rooms is dependent on the outside temperature and the excellence of the wall insulation and is independent of the amount of frozen fish in the room, requiring no more freezing material to keep 50 tons of frozen fish at an even temperature than to keep 2 tons in a room of equal size. With 16-inch or 18-inch walls well insulated, it requires the melting of about 40 pounds of ice per day for each 100 square feet of wall surface when the outside temperature is 60° F. to maintain a temperature of 18° F. inside, this calculation leaving the opening of doors and the cooling of fresh material out of consideration. All calculations as to the quantity of ice used in ice-and-salt freezing are based on the use of natural ice, for artificial ice is rarely used in those freezers. Since artificial ice is usually colder than natural ice, less would be required. The temperature in the storage room should be constant, and about 16° or 18° F. is considered the most economical. Above 20° the fish are likely to turn yellow about the livers, a result generally attributed to the bursting of the "gall."

The storage room should be free from moisture, since the latter offers a favorable place for the settlement and development of micro-organisms of all kinds, which tend to mold the fish. To reduce excessive moisture, a pan of unslaked lime, chloride of calcium, or other hygroscopic agency, may be placed in the room, the material being renewed as exhausted. If the storage rooms are very moist, they should be dried out before storing fish in them, this being readily accomplished by using a small gas, coke, or charcoal stove. The storage rooms using ammonia may be dried by passing hot water through the pipes, which of course should, under no circumstances, be done when there are fish in the rooms. In case of mold appearing on the fish it might be well to try spraying them with a solution of formalin, which is a 40 per cent solution of formaldehyde gas in water. The solution, containing 10 parts of formalin and 90 parts of water, should be sprayed over the fish at the first sign of mold.

All fish deteriorate to some extent in cold storage, depreciating both in flavor and firmness. The amount of this decrease is dependent primarily on the condition

of the fish before freezing and the care exercised in the process of freezing, and, secondarily, on the length of time they remain in cold storage. The loss in quality during storage is due principally to evaporation, which begins as soon as the fish are placed in storage and increases as the ice coating is sapped from the surface.

Evaporation proceeds at very low temperatures, though not so rapidly as at higher ones; even at a temperature of 0° F. the evaporation during two or three months is considerable. The heavier the ice coating the less the evaporation, but it is almost impracticable to entirely prevent it, and under ordinary conditions it amounts to about 5 per cent in weight in six months, but the loss in quality is greater than the loss in weight.

The method generally adopted of restricting evaporation other than coating with ice is to wrap the fish in waxed or parchment paper and place them in shipping boxes whose length and width are slightly larger than the blocks and deep enough to contain 4 or 5 blocks, or 120 to 150 pounds of fish, the inside of the box being lined with wrapping paper.

A method of largely reducing evaporation was invented and patented in 1880 by Mr. W. B. Davis, of Detroit, Mich., but it is scarcely sufficiently practical for general use, especially with cheap grades of fish. It consists in freezing the fish as above described, except that they are packed in fine pulverized ice in the pans before being frozen, and when taken out of the pans the fish are found solidly imbedded and incased in the block of pulverized ice.

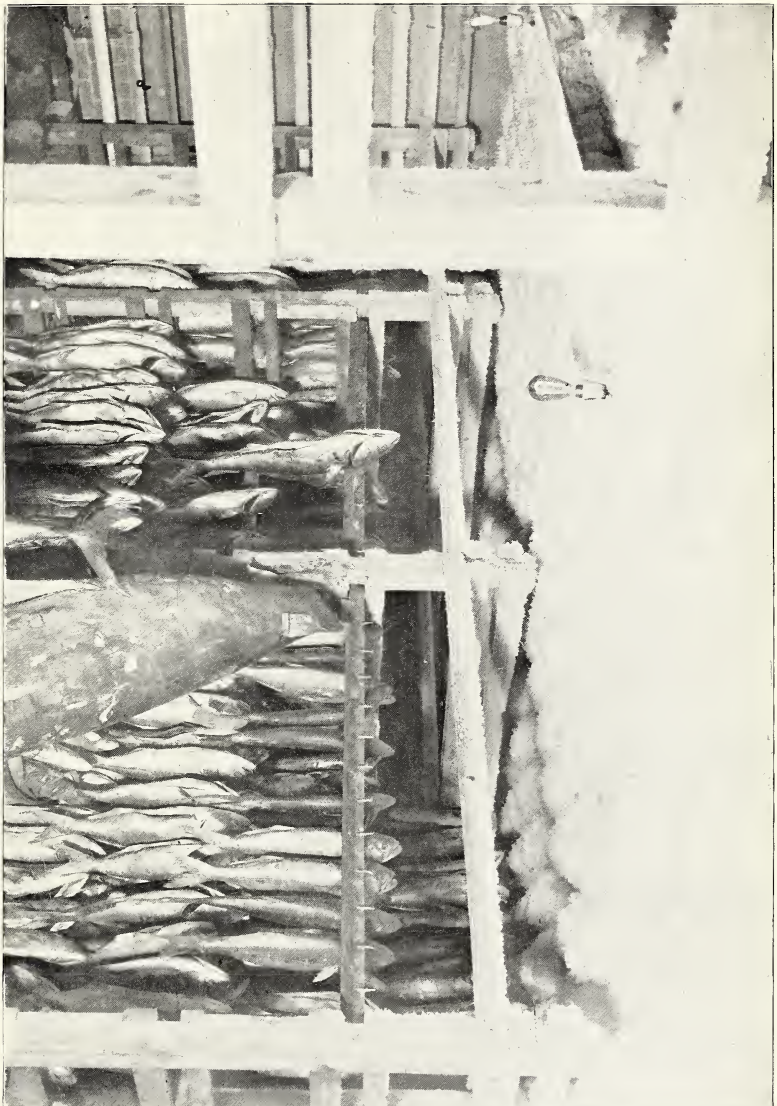
Along the Great Lakes the most popular fish for cold storage are whitefish, lake trout, lake herring, blue pike, saugers, sturgeon, perch, wall-eyed pike, grass pike, black bass, catfish, and eels. In addition to these species the Great Lakes freezers receive considerable bluefish and squeteague from the Atlantic. On the Atlantic coast bluefish, halibut, squeteague, sturgeon, mackerel, flatfish, cod, haddock, Spanish mackerel, striped bass, black bass, perch, eels, carp, and pompano, are frozen. Salmon, sturgeon, and halibut are the principal species frozen on the Pacific coast.

Some varieties of fish are so very delicate that it is not deemed profitable to freeze them, especially shad, but even these are frozen in small quantities. Oysters and clams should never be frozen, the best temperature for cold storage being 35° or 40° F. When stored in good condition they will keep about six weeks. As an experiment they have been kept for ten weeks, but storage for that length of time is not advisable. Caviar also should never be frozen, but held at about 40°. Scallops and frog legs, however, are frozen hard in tin buckets and stored at a temperature of 16° to 18° F. Sturgeon and other fish too large for the pans are frequently hung up in the storage rooms by large meat hooks, and when frozen are dipped in cold water and stored in piles. But when intended for shipment sturgeon are usually cut into pieces of suitable size for packing in the shipping boxes.

In some of the largest freezing houses on the Atlantic seaboard, which freeze and store fish as well as other food products, the fish to be frozen are simply hung up in the sharp freezer, the heads being forced on to the sharp ends of wire nails protruding from cross lathes arranged in series. After the fish are frozen they are removed and piled in storage rooms, where the temperature is about 15° or 18° F. (See plate XII.)

Where the handling of fish is of minor importance compared with other food products, the fish are placed on slat-work shelves in either a special freezing room or in a storage room where the temperature is kept below 20° (see plate XLI, lower half), or

PLATE XII.



FREEZING ROOM OF AMMONIA PLANT AT BOSTON, MASSACHUSETTS, SHOWING METHOD OF SUSPENDING FISH FOR FREEZING

they are retained in bulk in baskets, boxes, or barrels in the same room; but these methods are not productive of results even approximating those in the Great Lakes fish-freezers and should not be used where quantities of fish are handled.

The cost of cold storage and the deterioration in quality make it inadvisable to carry frozen fish more than nine or ten months, but sometimes the exigencies of the trade result in carrying them two and even three years. In the latter case they are scarcely suitable for the fresh-fish trade unless the very best of care has been exercised in the freezing and storage, and it is usually better to salt or smoke them.

The rate of charges in those houses which make a business of freezing and storage for the general trade is usually from ½ cent to 1 cent for freezing and storage during the first month, and about half of that rate for storage during each subsequent month, dependent on the quantity of fish. However, the cost of running a first-class plant at its full capacity is probably less than one-third or even one-fourth of the minimum above quoted, since it costs no more to run a storage room full of fish than one-fifth or even one-tenth full.

The refrigeration of fish on the Pacific coast, according to Mr. W. A. Wilcox, dates practically from 1890, since when it has steadily increased, the aggregate shipments from Oregon and Washington in 1895 being 236 refrigerator carloads, or 5,872,533 pounds of fresh fish. This consisted chiefly of salmon from Columbia River and Puget Sound, with 1,161,715 pounds of dressed sturgeon and a small amount of halibut and smelt. Mr. Wilcox, on pp. 587–589 of the Fish Commission Report for 1896, describes the process of refrigeration and shipment as follows:

On the reception of the fish at the cold-storage plant they are washed, wiped dry, and then placed on racks attached to trucks; these are run into the freezing rooms where, in a round or undressed condition, the fish are solidly frozen. From the freezing rooms the fish are taken to the packing and storage rooms and packed in cases holding 250 pounds of fish each. In packing, no ice is used. In some cases the fish are "glazed" with ice. This process consists in dipping the frozen fish in tanks of water that are in a room with a temperature of 20° F. On removing the fish from the water they are at once glazed or coated with ice, repeated dippings adding to the thickness of the icy coat. Glazing is an extra precaution to keep the fish from the air. In some cases each fish is wrapped in brown rag paper, in oiled paper, and in brown paper, as an additional protection from the air. The fish having been frozen and packed, the cases are removed to cold-storage rooms and held until needed for shipment. When placed in the refrigerator cars the latter are charged with ice that, except from some unusual delay, lasts the entire trip to the Atlantic coast.

During the past few years the experimental shipment of fresh frozen fish from America to Europe has become of considerable importance. The pioneer shippers had much to learn and their shipments were often under many disadvantages. Sometimes shipments arrived at their destination in prime condition and again were only fair or poor. Frozen fish from America was a new article of food and time was necessary to acquaint the people with them. The markets, as in this country, were often fluctuating and shipments were sometimes sold at a loss. On the whole, results were satisfactory enough to encourage and build up this new branch of the fisheries. The shipments of 1895 included 300 tons of steelhead trout and 200 tons of silver and chinook salmon. Until quite recently the steelhead was but little thought of, but with the increasing demand for fresh fish it has grown to be the most popular of the several species shipped long distances. While not having as much oil as some other species, it is a fine fish, and stands transportation much better than other fish of the salmon family. One case is on record in which steelheads frozen solid and shipped to England, after being received and the frost removed, were placed on the market, and the fish had such a fresh look, as if just from the water, that the dealer was arrested for having on sale fresh fish illegally caught.

Hamburg is as yet the favorite point shipped to, from which the fish are distributed all over the Continent. At New York the cases of frozen fish are transferred from the refrigerator cars or cold-storage rooms on shore to those on board of the steamer, the Hamburg steamers receiving and putting in cold storage any number of cases of fish offered. The distributions from Hamburg are made

by packing cases of frozen fish into small truck cars holding from 1 to 2 tons each. The cars are taken upon local steamers that radiate from Hamburg to many far and near ports. During 1895 shipments from Hamburg brought from 30 to 60 pfennig, (or from 7½ to 15 cents) net a pound, freight excepted.

In connection with the present quite large shipments of fish to Europe, notice of a small shipment from New England to Hamburg as far back as 1876 is of interest. During March of that year Mr. J. L. Griffin, then engaged in the fish business at Eastport, Me., made an experimental shipment of fresh frozen salmon that had been taken from the waters of New Brunswick. Mr. Griffin states:

"The salmon having been frozen solid were packed in a box which was inclosed within a second box with an air chamber of 1½ inches between the boxes. These were placed inside of a third packing case with a space of 1 inch between, this space being filled with sawdust. The fish arrived at Hamburg in good condition, but could not find any market as fresh frozen fish, such an article then being unknown. The frost having been removed, the fish were smoked and met a ready sale."

This small shipment not meeting with success, the attempt to introduce fresh frozen salmon from the Atlantic coast to Europe was for the time discontinued. After many years, with new methods of freezing, packing, and shipping, it has been successfully and extensively renewed from the Pacific coast.

For the purpose of economizing in freight charges on ice, the following method is used for shipping frozen salmon and other fish from the Pacific to Atlantic coast points: The frozen fish are first carefully packed in boxes and placed in refrigerator cars previously reduced to a low temperature, the floor of which is covered with several inches of cold sawdust. Between the boxes of fish and the sides, ends, and top of the car is a space of several inches, which is also filled with cold sawdust tightly packed. When filled, the car is at once closed, and no ice is placed in the tanks, as it is found by extensive experience that fish so packed for shipment reach their destination in perfect condition, even after a passage of two weeks or more.

Messrs. Seufert Bros. Co., of The Dalles, Oregon, state:

With frozen salmon, the fish are frozen solid as soon as caught, piled in cold storage like cord wood in a woodhouse, until time gives a chance for packing, which is done at our leisure. Then they are dipped in cold water and taken out at once. This forms a very thin coat of ice on them. They are then wrapped in oiled paper with an extra heavy paper wrapped over that. They are then put in boxes of 300 pounds net fish, lined with paper, and held in cold storage as long as one wishes. When they are shipped in refrigerator cars we put 6 inches of sawdust on the floor of the cars. The boxes are so made that we have about 2 or 3 inches space from the side of cars, which is filled with sawdust, and the top is filled over with 6 inches of sawdust. This sawdust must be fine and dry. Then we put 2 tons of ice in the car boxes with 2 sacks of salt, and the car is ready for a freight run across the continent of from 11 to 14 days. On reaching New York the fish are put in cold storage. If they go foreign, they go directly into the steamer's cold rooms and are not opened until they reach their destination. Frozen salmon will keep perfectly for 10 months; after that they lose ground.

The process of refrigeration applied to sturgeon on the Columbia River when shipped to eastern markets is as follows:

The fish are first beheaded, eviscerated, and skinned. The backbone is then removed and the fish cut into suitable sections for freezing. The sections are packed into galvanized-iron pans 24 inches long, 16 inches wide, and 5 inches deep. The pans are then put into a freezer charged with ice and salt, and their contents frozen into solid blocks of fish weighing about 60 pounds to each pan. The process is precisely similar to that in vogue on the Great Lakes for freezing fish. When frozen, the fish are removed from the pans and packed in boxes, four blocks to each box, and then loaded into refrigerator cars. The cars are charged with ice and salt to keep the temperature below the freezing point. In winter the cars do not usually require to be recharged before they reach their destination, but when the weather is warmer it is sometimes necessary to recharge with ice and salt once or more while in transit. (Report U. S. Fish Commission, 1888, pp. 226, 227.)

A process quite similar is applied to freezing sturgeon on the Delaware River, the frozen fish being then stored for the fall and winter markets.

FISH STORAGE ROOM OF AMMONIA PLANT AT MINNEAPOLIS, MINNESOTA, CONTAINING MISCELLANEOUS FISH.

FISH STORAGE ROOM OF AMMONIA PLANT AT CINCINNATI, OHIO, CONTAINING STURGEON, LAKE HERRING, ETC.

FREEZING FISH IN EUROPE.

An account of the condition of the frozen-fish trade in Europe has recently been received from Mr. Nicolas Borodine, of the department of agriculture of the Russian Government, of which the following is a partial translation:

In the regions of western Europe, not including Norway and Switzerland, the winters are so mild that fish naturally frozen are not found on the market; hence a strong prejudice has arisen among the Germans and French against fish in that condition. They express the opinion that frozen fish lose their savory qualities, and they esteem them far less than the unfrozen. In consequence of this prejudice frozen fish have not hitherto found much sale in the European markets, although efforts have been made in that direction.

At the end of the eighties an attempt to procure fish in the frozen state throughout the entire year was made at Marseilles. A company was organized there, under the name of the "Trident," which had a sailing vessel furnished with apparatus for freezing fish caught on the west coast of Africa. The selection of Marseilles as a market was unfortunate; in the first place, because the men of the south, never having seen frozen fish and not eating them, utterly refused to buy them; and, in the second place, the inhabitants were entirely unaccustomed to the kinds of fish which were imported. Hence the company was soon compelled to wind up its business. The spread of reports of the worthlessness of frozen fish as food, of which the French were at that time convinced, contributed no little to this failure. In their opinion tainted fish imported in warm weather were better than frozen fish. Hostility was even aroused at first against fish brought in ice from Algiers to Marseilles. These, they said, are not fresh fish, but preserved fish, and therefore it must not be sold in the market as fresh fish.

Another attempt of a similar kind was made by the Norwegians in the Hamburg market in the nineties. The North Cape Joint Stock Company built a special steamer, the *North Cape*, with cold-storage rooms (low temperature being obtained by means of machinery), which were filled with "*Gadus æglifinus*" (haddock). The steamer arrived at Hamburg with a full cargo. In the first year hardly any customers were found for the frozen fish, and a part of the cargo was carried back. According to the reports for 1892–93 (see note by Mr. Heinemann in Pisciculture of the World, 1893, No. 12, p. 395), this company built a large cold-storage warehouse at Vardö, in Norway, at a cost of 200,000 German marks [$47,600]. The fish are caught on the spot, are frozen, and placed in the cold-storage warehouse in a temperature of 5° Reaumur [18¾° F.]. The shipment on the steamer at that temperature is usually made in the autumn. A cold-storage warehouse for frozen fish, with a capacity of 21,000 poods,* was also built in Hamburg. A railroad goes to the warehouse, and the frozen fish are shipped to any point in Germany by rail.

Fish are sent in a fresh state by rapid transit to Munich, Leipzig, and Vienna. To give an idea of the demand, it is stated in the note already quoted that of 9,000 poods shipped to Hamburg on the steamer *North Cape*, November 14 (26), 1892, 5,200 poods were sold in the first week and the remainder of the cargo in the following week.

Judging by statements made in the German weekly, *Deutsche Fischerei-Zeitung*, the prejudice against frozen fish is rapidly diminishing, owing in great measure to the fact that frozen fish are sold much cheaper than fresh fish shipped in ice; and it may be asserted that the same thing will occur in this case as in the case of the frozen meat from South America and Australia, which is now sold in large quantities in the great commercial centers.

In Paris the cold-storage warehouse is under the Bourse, and is under the management of the Compressed Air Company of Paris. The central station and the office of that company are 56 Rue Etienne Marcel, from which point the compressed air is carried in pipes to many places in the city as a motive power. The employment of compressed air for freezing purposes is based upon its rapid expansion, by which the surrounding atmosphere is rendered extremely cold. For the rarefaction of the compressed air conveyed into the basement of the Bourse a special engine is employed, by which the refrigerated air is carried into the compartments formed by the double wall of the refrigerating rooms. The walls are lined on the inside with tin, painted a whitish color, and on the outside with materials which are nonconductors of heat (layers of moss on wood). Every room is furnished with a ventilator to carry off the damp air. There are 16 rooms, and each of them can be refrigerated separately, and to any temperature near zero or below zero. They are arranged on both sides of the

*One pood equals 36.112 pounds.

main corridor. They are rented at 2 francs per square meter of surface if the goods are to be subjected to a temperature above zero, and 3 francs per square meter of surface if a temperature below zero is wanted.

In London there are cold-storage warehouses at the Central Market, which belong to a company called "The Central Markets Cold Air Stores, Limited." The immense cellars of the enormous London meat market are used for these warehouses and have a capacity of 1,000 tons. The warehouses are used partly by the company itself, which does business in Australian frozen meat; and are partly rented to butchers at £2 per ton for four days. Besides meat a large quantity of game is stored here, including 100 tons of poultry from Russia annually. The whole underground market consists of a series of large rooms with thick insulated walls. A square wooden pipe, the sides of which are also insulated, passes along the ceiling of all the rooms in the basement; and there are orifices in this main pipe in every room through which cold air can be admitted. Here, too, the refrigerating process is based upon the expansion of compressed air. At first the air is compressed by steam power. It is then driven violently into a vacuum, where, as it expands, it lowers the temperature. From this room the refrigerated air is conveyed into conducting pipes for general distribution. These engines are built on the Bell & Coleman system and are constructed in England by the firm of Holsam & Co., Engineers, Derby. The temperature can be regulated at will. For meat it ranges from 14° to 9° F., but never higher than 14°.

The exportation of frozen meat from Australia has lately attained great dimensions. Forty steamers, equipped with apparatus for the transportation of frozen fish, run to London.

Freezing by machinery, for the storage of fish, was first employed in Russia at Astrakhan, by Mr. Supuk, who first built an ice barge for freezing by means of air engines of the Lightfoot system. This occurred in 1888. In this new enterprise Mr. Supuk was subjected to great losses through his failure to induce others to send their fish to his barge. Not obtaining any cooperation on the part of the fish-dealers of Astrakhan, and becoming convinced that he would have to procure fish for himself, Mr. Supuk, in 1891, requested the aid of the Russian Fishery Association, which, however, could not furnish him any material assistance, but which, through its members and by articles in the press, greatly contributed to the establishment of this new business. Recently Mr. Supuk's business has been considerably enlarged and is on a firm footing.

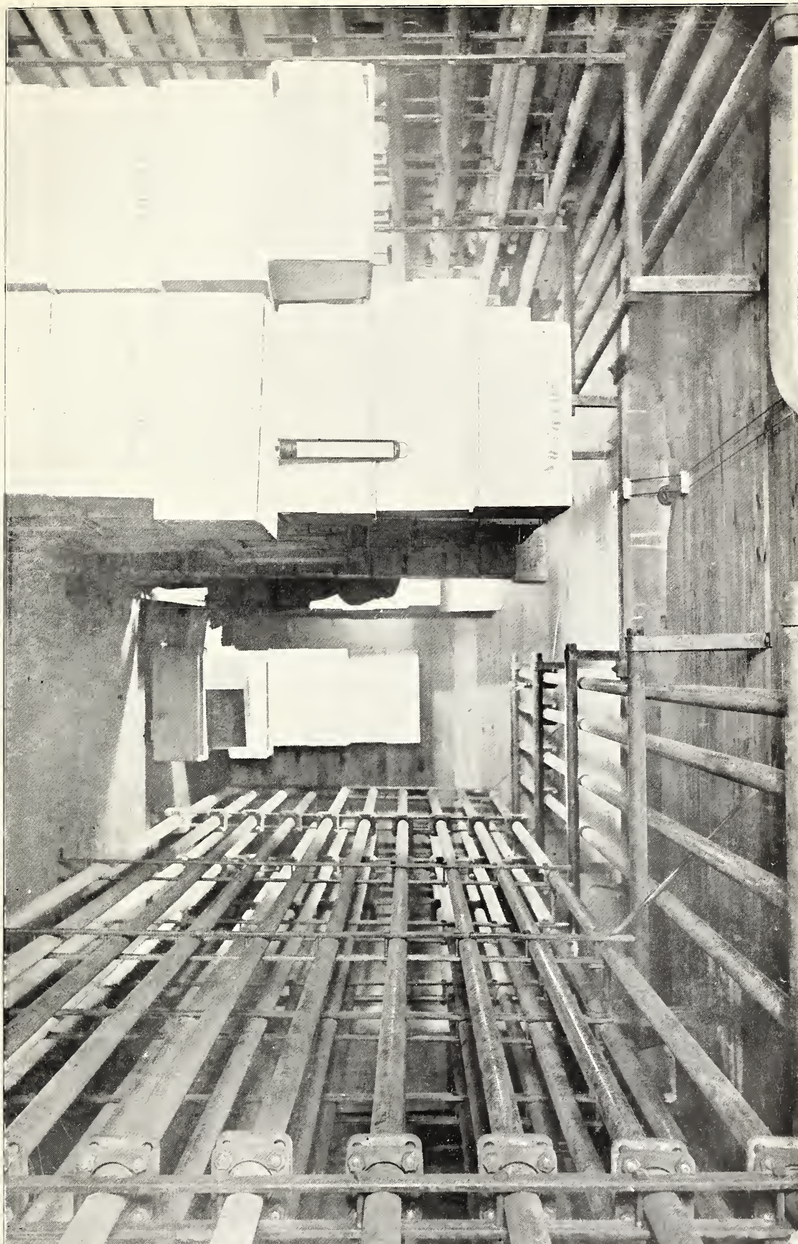
I borrow from Mr. A. K. Heinemann, who inspected Mr. Supuk's ice barge at the time of its construction, some of the chief details concerning it. Its capacity is estimated at 10,000 poods. It is intended to freeze and to transport in the frozen state not only large but small fish. It is fit for going to sea and for ascending the Volga as far as Nijni-Novgorod. The cold-storage room occupies nearly the whole length of the barge, and is formed by double walls with the space between them filled with sawdust. The walls are at a little distance from the sides of the barge, and the ceiling of the room does not reach the deck, so as to avoid heating. The engines stand, one in the bow, the other in the stern of the barge. The chamber contains five sections, two of which serve for freezing fish and the middle ones for storing fish. In the former the temperature is about 12° R., in the latter it is kept at 2° to 3° R. The capacity of the two freezing chambers is 450 to 500 poods [16,200 to 18,000 pounds]. The largest fish is frozen through and through in 24 to 36 hours. The cold air, in its passage from the engines to the freezing chambers, is conveyed through a separate snow chamber, in which the superfluous moisture of the air is condensed in the form of snow; from there the cold air is conveyed through wooden pipes to the freezing chambers and the cold-storage rooms. The admission of the air is regulated by espagnolettes.

Having procured the capital needed for the whole operation of the purchase and sale of fish on his own account, Mr. Supuk built at Astrakhan, on the bank of the Volga, a stone edifice for freezing fish and for storing the frozen fish, and the barge is used exclusively for the transportation of the frozen fish from Astrakhan to Tsaritsin. On the whole, the undertaking proved very profitable, and Mr. Supuk is extending his business, making improvements, and proceeding to the construction of a second barge, intended for the southern part of the Caspian Sea. The new barge has a capacity of 25,000 poods [450 tons] of fish. The freezing machine is placed in the middle of the barge. It is furnished with electric light.

Freezing by machinery is carried on on a still larger scale by the great fish firm of Vorobieff, at Petrovsk, which has built large cold-storage warehouses, at a cost of 185,000 rubles [$71,865].

A mixture, composed of ice and salt, is employed for freezing fish at Mariupol and Henichesk.

Judging by the printed reports, fish are frozen at Mariupol in tubs made for the purpose [4 by 2½ by 2 arshines] with a capacity of 100 poods [3,611 pounds], in which the fish are kept for days in a



STORAGE ROOM OF AMMONIA PLANT AT MINNEAPOLIS, MINNESOTA, SHOWING ARRANGEMENT OF CIRCULATING PIPES

mixture of ice and salt [10 per cent of the latter]. When frozen, they are taken out and shipped in baskets by rapid transit to Kharkoff, Moscow, and other great centers.

At Genichesk the freezing of dolphins and sturgeon is carried on in an ordinary cellar constructed on the seashore. In the spring and autumn the cellar is used for salting the fish, and in the summer when the dolphin fishery is mostly carried on in the sea, the chests from which the fish are taken are used to freeze the fish. This is done in the following manner: A layer of ice, 1 arshine * in depth, is laid on the bottom of the chest; this is covered with salt; on this is placed a layer of fish which is covered with a fresh layer of ice and salt of half an arshine, and so on to the top. The fish remain in this condition for 3 weeks, not longer, and are frozen, as in winter, in 24 hours after they are placed in the chest. If it is necessary to keep the fish longer than 3 weeks they are taken out of the ice and placed in boxes containing gratings in order that the cold may penetrate them and to prevent the fish from becoming soft by not being sufficiently salted. If it is intended to take the fish out within a week, the first layer of ice is made only one-half arshine deep and the others much less. The capacity is 7,000 poods of frozen fish. The whole shipment from Genichesk amounts to 20,000 poods every summer. The frozen fish is shipped mostly to Kharkoff where it arrives in 24 hours, and may go as far as Moscow. It is sent with great rapidity, in baskets containing 10 poods, with a mat over the top.

At the place of the catch the dolphins are sent direct in fresh condition to the freezing establishment, where they are frozen. On islands at a distance from Genichesk, ice is stored on the spot and the fish are frozen there by being buried in the ice, and are then shipped at night on sailing vessels when the wind is favorable.

The same method has been employed recently at Uralsk for freezing sturgeon, and the frozen sturgeon of the spring catch are shipped to Busuluk and Orenburg. In order to show the fish-dealers the construction of the cold-storage rooms of the American type, for the preservation of frozen fish, a room of that kind was constructed at Uralsk after my plans. The whole operation of freezing the fish and the construction of the room itself have been several times explained in this miniature warehouse; and an opportunity of inspecting it is offered at any time to those wishing to do so.

There is no doubt that freezing fish in the ordinary ice-house appears to be the simplest method, as it requires no special buildings and is done in the common cellar ice-house, part of the ice in which serves for that purpose. The large fish, as I succeeded in ascertaining by personal observation, are frozen very thoroughly by this means and lose nothing of their external appearance. The time during which the fish can be preserved by this method, however, is limited. The fish must be taken out within a week or a week and a half; otherwise the brine acts upon the frozen fish, and it becomes soft and dark. Besides, this method can only be applied where there is a large stock of ice on hand, as is the case in vaults which are also used for other purposes.

In view of what has been said, we must conclude that for Russia, in places where there are fisheries, the most expedient mode of cold storage consists in a combination of the vault and the cold-storage rooms of the American type for the preservation of frozen fish. By means of such combination, in the first place, the space may be used for the ordinary purposes of the spring and autumn salting; in the second place, the largest fish can be easily frozen by direct burial in the ice without any great expense for labor; and in the third place, when the frozen fish are taken out of the ice, they can be stored for the longest period in the cold-storage rooms of the American type.

FREEZING HERRING FOR BAIT.

The demand for fresh herring as bait in the cod fisheries led, in 1890, to the building of a number of freezing houses along the New England coast, where shore herring are frozen during the fall and kept for use during the winter and early spring. Most of these were of the direct anhydrous ammonia absorption system and were designed by M. J. Paulson, of Gloucester. From 1890 to 1893 the following plants, with the designated capacities, were constructed: Gloucester, 4,500 barrels; Rockland, 10,000 barrels; Boothbay Harbor, 4,000 barrels; Provincetown, 3,000 barrels; North Truro, 3,000 barrels. The Rockland freezer did not pay and was dismantled in 1894. The walls of the storage chambers in these plants are thick and well insulated. About the walls on the inside are ranged the ammonia pipes in nests of horizontal rows, the

* One arshine equals 28 inches.

distance between the rows being 4 or 5 inches and between each pipe in the rows 3 or 4 inches. The herring are thrown on hand boards of lattice or small flake platforms, which are placed on the various rows of pipes, and are frozen, the temperature during the process being sometimes 15° F. or lower. They are afterwards stored in heaps on the floor between the nests of pipes and additional fish are placed on the lattice boards.

The plant at North Truro, Mass., is thus described by the engineer, Mr. E. R. Ingraham:

Our building is of wood, 100 feet long, 40 feet wide, and 3½ stories high. Our sharp freezer is on the third story; it is 70 feet long, 30 feet wide, 8 feet high, and contains 10,896 feet of 1½-inch pipe arranged in four coils running the length of the building. The pipes are 12 inches from center to center. Upon these coils are placed wooden flakes, or shelves, 6 feet long and 4 feet wide. Upon these flakes the fish are placed to be frozen. The capacity of the machine is 125 barrels in 24 hours.

As soon as the fish are frozen they are put down through scuttles into the storage rooms, which are four in number and contain 8,400 cubic feet each. Here the fish are held at a temperature of 15° above zero. In our sharp freezer we carry a temperature of from 15° to 15° below. We have two machines of the absorption type—direct expansion. The temperature of our condensing water is 52°. We carry 140 pounds high pressure on the generator, 3 to 10 pounds on absorber, 40 pounds of steam on generator, and 60 pounds of steam on boilers. We burn on an average one ton of coal every 24 hours. The fish are all caught in weirs about one mile from the storage. They are brought in boats to the shore, where they are dressed and washed clean; then they are hoisted to the top of the third story, whence they go down through scuttles into the freezing room, where they are frozen solid.

There are also two ice-and-salt refrigerator plants on the New England coast, one at Gloucester, Mass., with capacity for 3,000 barrels of herring, and the other at Boothbay Harbor, Me., for about 500 barrels. Some food-fish also have been frozen in these refrigerators, but they are used principally for preserving herring for bait.

In the fall of 1898 the schooner *J. K. Manning*, 282 tons, and the barge *Tillid*, 425 tons, were fitted up at Gloucester with direct ammonia absorption freezers and sent to Newfoundland for the purpose of freezing herring and squid for bait. The capacity of the former is 3,000 barrels and of the latter about 2,000 barrels.

A very cheap and ingenious device, known as the Wallems freezer, is used for freezing small quantities of herring for bait in Norway and in Newfoundland. The cost is small, the only materials required being ice, salt, and a stout barrel. Within the barrel four wooden flanges are fastened to the sides and running diagonally or at an angle with the axis. The barrel is one-half filled with a mixture of crushed ice and salt, in a proportion of about three parts of ice to one of salt. In case of ice not being obtainable, snow will suffice. The barrel is loosely filled with fresh herring and headed. It is then placed on its side and rolled on its bilge one or two turns forward and then backward one or two turns, the rolling being continued for about 15 minutes, at the end of which time the herring are generally thoroughly frozen, when they are placed in dry sawdust until used. The flanges inside the barrel are placed at an angle with the axis so as to aid in mingling the fish with the ice and salt when the barrel is rotated.

The rate at which the barrel should be rotated is easily determined by experience, and the salt and ice may be used over again as long as they last, but it is usually desirable to add some additional salt and ice. For convenience in handling, the barrel may be suspended from an axle and rotated by means of a crank, the fish, ice, and salt being admitted and removed through a hinged-lid opening in the side of the barrel.

DRYING CODFISH IN FLAKE-YARD AT GLOUCESTER, MASSACHUSETTS.

PRESERVATION OF FISHERY PRODUCTS BY DRYING AND DRY-SALTING.

Next to heat, moisture is the greatest aid in the development of bacteria, and its removal constitutes one of the most important processes of preservation, being applied to a variety of foods, as fruits, cereals, and occasionally to the curing of meats, but its most important application is to the curing of fish. The moisture may be removed in several ways—by exposure to the air, by pressure, by combining with the fish certain substances possessing a strong affinity for water, such as salt, by use of absorption pads, etc.

Drying in the open air is the most ancient method of preserving fish, it being the principal method in vogue among the Phœnicians, and up to the present time it has been employed to a greater or less extent in nearly every fish-producing country, either in its original form or with certain modifications tending to assist in removing the moisture. The use of salt performs a twofold function in curing fish, it acting as an antiseptic as well as diminishing the amount of moisture. Fish can be cured equally hard by resalting with dry salt several times at suitable intervals as by drying in the open air. But the former is impracticable on the score of economy and the latter is not generally employed exclusively, because of the unsuitable climatic conditions, and in America it is most practicable to combine the two methods with the addition of compression, the fish being first salted in butts and afterwards pressed and dried.

The original process of curing fish solely by drying in the sun is very little used in this country, as there are few localities where the air is adapted to it. The Indians of the Northwest dry a number of species, among which are halibut, salmon, cod, eulachon, smelt, etc., and at a few other localities some minor species are dried, but the business is inconsiderable and there is no general traffic in these products.

In Norway, Sweden, and Russia, and other countries of northern Europe, where the air is comparatively free from moisture, cod are yet dried without the use of salt, but Norway is the only country that prepares large quantities in this manner. The fish are beheaded, eviscerated, and cleaned with sea water and suspended in the air on stands about 8 feet high, where they remain for weeks, and even months, until they are hard enough to withstand the strongest pressure of the tip of the thumb in the thick of the flesh along the back without giving way, and it is necessary to soak them in water for several hours before preparing them for the table. This is known as the stockfish cure, and the annual product in Norway exceeds 400,000 quintals, which is marketed in Germany, Italy, Portugal, Spain, Brazil, and other countries, especially those located in the Tropics.

In the United States, the British North American Provinces, France, Iceland, and certain other countries the greater portion of the desiccation is performed by salt, the fish being first salted and then dried; but in each country the methods differ in some particulars, as in the quantity and quality of salt used, the extent of the drying, the length of pressing, etc., depending not so much on the caprice and fancy of the individual curers as upon the market for which the fish are intended, regard being

paid to the appearance and keeping qualities of the product. In curing codfish for the New England trade about 64 per cent of the moisture is removed—59 per cent by the salting and 5 per cent by pressing and drying. 100 pounds of split cod contain about 80 pounds of water; and, in the process of curing, 51 pounds are removed by the action of the salt and 4½ pounds by pressure and drying. Norwegian stockfish has been freed from about 96 per cent of moisture by atmospheric drying alone.

The principal marine products to which this process is applied are cod, hake, haddock, cusk, pollock, mullet, shrimp, channel bass, barracuda, bonito, and salmon, but as its application to the cod and its related species is the most extensive and valuable, the methods of treating those species will be first described.

DRIED CODFISH.

In speaking of codfish generally the various species of *Gadidæ* common on the New England coast are usually referred to, the most important being the cod (*Gadus callarias*), haddock (*Melanogrammus æglifinus*), pollock (*Pollachius virens*), hake (*Merlucius bilinearis*), and cusk (*Brosmius brosme*). The proportion of these entering into the dried-fish trade is about as follows: Cod, 83 per cent; hake, 10 per cent; haddock, 3 per cent; pollock, 3 per cent, and cusk, 1 per cent.

The greater portion of the dry-salted codfish in America is obtained from the bank fisheries, especially from Grand Banks and vicinity. Many are also received from Georges and other neighboring banks, representing the surplus from the fresh-fish trade. Gloucester is the principal market for this article, while Portland, Provincetown, Boston, Boothbay Harbor, and other ports handle large quantities.

In large ports, especially Gloucester and Boston, most of the product is prepared as boneless fish, but in the smaller places the fish are usually dried more thoroughly for distant markets. During the eighteenth century and the early part of the present century codfish were prepared largely for export, and consequently were made quite dry, so as to keep for several months in warm, moist climates. At present, however, the great bulk of the product is intended for domestic consumption and is not so thoroughly dried.

It was formerly customary for United States fishermen on the Grand Banks and in the Gulf of St. Lawrence to land on the rocky shores of Newfoundland and other British Provinces to cure their fish. In that case the fish were split, salted, and kenched in the vessel while on the banks, and on landing they were dried upon the rocky beaches. After curing the fish many of the vessels carried them directly from the provinces to Spanish and other ports, where they were sold and a return cargo of merchantable products was brought home. The privilege of landing to cure fish was considered quite valuable and occasioned much international controversy. By the treaty of 1818 the fishermen of the United States were allowed to land and cure their fish within certain prescribed limits, which were increased in extent by the Washington treaty of 1871. But during recent years this privilege has been of no value, as the fishermen have brought all their catch directly home to be prepared by regular fish-curers.

The present process of curing cod, haddock, hake, cusk, and pollock, which is essentially the same as that in vogue a century ago, except in the amount of drying, is as follows, this description being especially applicable to the fishery on the Grand Banks and to the preparation of fish for the domestic trade:

The dressing is begun as soon as the dories return to the vessel, or as soon as the day's work is over when fishing from the vessel's deck or from shore boats. Unless

this be done the cured fish are likely to have a dark color and the flesh be broken and loose, especially near the backbone. This is also noticeable in fish caught on trawl lines when stormy weather prevents the overhauling of the trawls for two or three days. Care should also be taken not to bruise the fish any more than is necessary and to protect them from the sun by means of tarpaulin or otherwise, if they are not to be dressed for several hours. It would improve the appearance of the cured product if the fish were bled as soon as practicable after removal from the water, but this is not a common practice in the New England fisheries, except in the vessel hand-line fishery, when the tongues are cut out, which is more particularly for the purpose of keeping count of each man's catch. The blood is subject to putrefactive action much more readily than the flesh, and if it remains in the pores it causes the color of the flesh to turn dark. The additional trouble of bleeding the fish would be slight, it being done by cutting the throat and the large vein near the neck bone.

A dressing gang on the usual Grand Banks vessel consists of a "throater," a "gutter," and a "splitter." The first named, taking the fish in his left hand by the head and resting it on its back on the edge of the tub, makes a transverse cut across the throat immediately behind the gills, with a strong, sharp-pointed knife. Introducing the knife at this opening, he cuts down the belly, laying open the abdominal cavity, and making also one cut on each side downward he separates the head from the sides. Then by pressure simultaneously upon the head and the body, the neck resting on the edge of the tub, he breaks off the head from the body at the first vertebra. The gutter, taking the fish, opens the abdominal cavity with his left hand and with his right hand tears loose and removes all the organs contained therein. The livers are thrown into a separate receptacle, while the stomach and other organs are with the heads thrown into the sea or into the gurry pen on the deck, whence they are discharged into the sea on changing the berth of the vessel.

The fish then passes to the splitter, who is provided with a knife rounded at the end and with the blade slightly curved flatwise. With the back of each fish braced against a cleat or batten nailed on the splitting board, he makes a long incision down the ventral surface, continuing the opening made by the throater, and also makes a straight, clean cut along the left edge of the backbone to the tail, inserting the knife no deeper than is necessary for cutting out the backbone. With a horizontal stroke he cuts through the backbone about two-fifths of the distance from the tail and loosens it so that he can catch the end in his fingers. Grasping this with his left hand he cuts under it toward the head of the fish and separates the upper three-fifths of the backbone from the body, the lower two-fifths remaining in the fish. In this operation the knife should be pressed close to the backbone, so that no flesh adheres thereto, otherwise the fish will be thin through the back. In dressing pollock nearly all of the backbone is removed because of the large quantity of blood along the bone. The French curers leave more of the backbone in the fish than is customary in America and elsewhere, and to remove the blood in the remaining portion they use a small iron spoon. The cut through the backbone should be horizontal toward the head, passing through two or three vertebra, and it should not be deep enough to damage the muscles lying along the backbone and thus weakening the lower part of the fish.

After removing the sounds or air bladders the backbones are discarded. Sounds sometimes sell at such a low price that it does not warrant saving them and they are discarded with the backbones. A slight incision should be made along the remaining part of the backbone to permit the escape of any blood that may remain.

The fish are then washed in tubs of sea water or by sousing water over them, especial care being taken to clean the neck, the remaining portion of the backbone, and the vicinity of the dorsal fins, and to remove the dark membrane that adheres to the napes. Even if the fish are dressed on shore, sea water is preferred for washing them, as fresh water has a tendency to make them slimy. In washing them in tubs the water should be changed frequently to prevent its becoming foul.

After the splitting and washing, with the subsequent draining, comes the salting, which is accomplished in two ways, forming the kench cure and the pickle cure. In the former the fish are placed with dry salt in regular piles or kenches, and the pickle which forms is allowed to run off, leaving the fish dry, and in the pickle cure the fish are salted in butts or barrels which retain the brine. The kench cure makes a drier product and one suitable for export to hot climates, but is rarely used in the United States except in combination with the pickle cure. Generally in this country the fish are salted in kenches on board vessel and in butts on shore.

In the Grand Banks fisheries, the fish, after draining, are passed to the salter in the hold of the vessel. Grasping each fish by the tail, he throws it upon the kench or pile, flesh side or face up, and with a small scoop sprinkles over it a quantity of salt. The kenches are built up in regular order, the fish being laid head to tail, spread out flat, with the back or skin down.

Salting requires considerable skill, the fish spoiling from insufficient salt and deteriorating in flavor from an excess. As a rule, the less amount of salt required for preserving the fish the better, but the salt should not be used sparingly. Some fishermen, in order to make their fish weigh heavy, put on too little salt and at times lose the fish as a result. Thin fish require much less salt than thick ones, and less salt is necessary in cold weather than in warm. Also those fish which are to remain a long time before being used require more than those to be marketed quickly. Experience is the only guide, but as a rule an even layer of salt thoroughly covering the fish and leaving no vacant places or finger marks is sufficient. Coarse salt is preferred to fine, especially for fish that are not to be marketed for a considerable length of time, as it does not go to brine so quickly. Formerly Cadiz salt, by which name all the Spanish salts are called in this country, was used, but during recent years Trapani salt has been employed almost exclusively, the use of the former being abandoned on account of its abundance of lime, which settles on the fish, and also its greater tendency to impart to the fish a reddish color, attributed to some vegetable matter contained in the salt, which develops rapidly during warm, moist weather. On an average, 1 bushel of Trapani salt is used to each hundredweight of fish in the Georges fishery, while the Grand Banks fishery usually requires 1½ bushels to the hundredweight of fish. Vessels engaged in the latter fishery usually carry about 200 hogsheads of salt in pens or compartments, each pen holding 15 or 20 hogsheads, and as the pens are emptied of salt they are used for storing the fish. The Georges Banks vessels, being absent a much shorter length of time, do not carry so much salt.

The fish remain in kenches until the vessel arrives in port, care being taken that no water reaches them. If the vessel is absent three or four months those fish caught during the first month or so are generally rekenched and additional salt sprinkled among them if it appears necessary. As the pickle accumulates and is driven out from the fish in the middle and lower parts of the kenches by the pressure of those above, the vessel must be pumped out frequently. Some fisherman claim that they

DRESSING AND WASHING COD FOR DRYING.

CODFISH SALTED IN BUTTS PREPARATORY TO DRYING.

can determine from the quality of the pickle pumped out whether the fish are keeping in good condition. If the pickle shows signs of being tainted, the fish must at once be overhauled and repacked.

As soon as the cod are landed on the dock they are culled, the principal grades being (1) large cod, which includes all over 22 inches in length salted; (2) medium or small cod, between 16 and 22 inches in length; and (3) snappers, which comprise the lowest grade. If the trip is from other grounds than the Grand Banks, the "scale fish" are separated from the cod; these comprise hake, haddock, pollock, and cusk. Of the cusk, two grades have been made during recent years, namely: (1) large, covering all over 19 inches in length salted; and (2) snappers, comprising all under 19 inches in length. Each grade is weighed separately and the fish are washed with clean salt water in tubs, vats, or old dories. If the fish have been kenched for two months or more they are sometimes rubbed with bristle or palmetto brushes to remove surplus or incrusted salt, etc.

They are next placed in large butts, usually old molasses or sugar hogsheads, each having capacity for about 900 to 1,000 pounds of fish. From 2 to 4 bushels of Trapani salt is sprinkled among the fish in each butt, this quantity depending on the degree and length of salting on the vessel. In the case of Grand Banks cod about 2½ bushels of salt are placed in each butt, whereas for Georges cod, which usually are not so heavily salted in the vessels, about 3½ bushels are required. With the exception of the bottom layer the fish are generally placed with the skin side up, but this is not the universal custom, some curers placing all the fish flesh up except the last two or three layers. Fish in butts take the salt better if placed face or flesh side up, and in case they have been only lightly salted it is best to place them face up; but if they have been thoroughly salted on board the vessel it seems immaterial whether they be placed face up or back up in the butts. The bottom layer is placed back down, to protect the fish from the bottom of the butt, and the top layers have the backs up as protection against dirt, dust, etc. On top of the pile is placed about half a bushel of salt, to strengthen the weak pickle which floats up to the surface. In case the fish have been but slightly salted on board the vessel, some curers hang over each butt a basket containing about a bushel of salt, through which water is allowed to percolate and, thus charged with brine, to flow into the butt, the salt in the basket being renewed as it melts away. The fish remain in the butts under shelter until orders are received, which may be a year or more, in that case more salt being added from time to time; but the sooner they are used after the first few weeks the better, otherwise they have a tendency to turn yellow, or in case of pollock they turn dark.

When orders are to be filled the fish are removed from the butts and placed flesh side down, except the first two layers, in kenches about 3 feet high, for the purpose of pressing out some of the water and giving the fish a smooth surface, this being known as "water-horsing." The following day they are again repiled in a similar manner, but with those fish in the upper half of the first pile placed in the lower half of the second. The water-horse should be made a little higher in the middle than on the sides, in order to facilitate the running of the moisture from the fish, and it should be put on racks about 3 inches high, to protect the fish from the moisture, dirt, etc., on the floor. In order to avoid water-horsing a second time, many of the curers place weights on top of the first water-horse, this being most easily accomplished by placing boards on the pile of fish and rolling empty hogsheads on top; but this is not

a desirable substitution for repiling, since the lower layers are thereby compressed more than the upper ones. All handling of fish from the vessel's hold to beginning the water-horse is generally done with pews or long-handled forks with one or two prongs to each handle.

From the water-horse the fish go to the flakes, which are of two kinds, stationary and canting, the former being the more common. They are about $2\frac{1}{2}$ feet high, 8 feet wide, and of convenient length, with passageways wide enough for handbarrows between the stands. The horizontal top, resting upon ordinary wooden horses 8 feet long and about 2 feet high, is in three parts: (1) The long joists 2 by $3\frac{1}{2}$ inches and 12 or 14 feet long; (2) the cross joists about $1\frac{3}{4}$ by 2 inches and 8 feet long; (3) the 1-inch triangular strips, upon which rest the fish. Three of the long joists run lengthwise of each stand, and to these are nailed the cross joists, about 12 inches apart, and to the cross joists are nailed the triangular strips, 3 or 4 inches apart. At each end and transversely at suitable intervals over the flakes are placed frames about 15 inches above the flakes, upon which cotton awnings may be stretched when the sun is hot. The canting frames differ from the above in that they are fixed only at the middle and to a horizontal axis, so that they can be turned at an angle with the horizon, in order to expose only the edge of the fish to the sun and to get the benefit of even a slight breeze. With these flakes cotton awnings are dispensed with, but very few of them are now used in this country, and they are practical only in yards running north and south. At Gloucester many of the flakes are on platforms built over shallow water. In Portland, Me., the roofs of the fish-houses are used as resting-places for the flakes, and at Rockport, Mass., the flakes are built on tall posts overhanging the sloping rocks, thus allowing the air to freely circulate beneath the fish. The old style of brush flake is not used at present on the New England coast, nor are codfish dried on the beaches in the United States, as is common in Nova Scotia and Newfoundland. About thirty years ago a form of flake was introduced having screens or slatted frames, like those of window shutters, arranged to protect the fish from the weather or to screen them from the rays of the sun, as circumstances may require, but its use was never extensive.

In carrying the fish from the butts to the flakes they are placed on wheelbarrows or on handbarrows, the latter being usually made of oak and consisting of two sticks about 6 feet long, with 5 crossbars, each 21 inches long, $2\frac{1}{2}$ inches wide, and $1\frac{1}{2}$ inches thick. For carting the fish from wharf to wharf a low platform 4-wheeled truck, called a jigger, is in common use.

The principal troubles in connection with curing fish are flies, sunburning, and softening. Flies are avoided by keeping the vicinity of the flakes clean and airy and free from all putrefying refuse. During some years the flies are so numerous that it is necessary to protect the slack-salted fish by sprinkling lime or salt about the flakes and yard to destroy the maggots. Sunburning is prevented by protecting the fish from the excessive action of the sun, and softening may result from a stinted use of salt on board the vessel, or from wet, cloudy weather during the process of curing. Cod and haddock burn quite readily unless properly protected, but there is little danger with hake and cusk, even on hot sunny days. Because of climatic conditions it is frequently quite difficult to cure codfish during July and August on the New England coast, the air being moist and the sun so hot as to sunburn the fish very quickly; but in October and November little trouble is experienced from this source. On the New England

DRYING CODFISH IN FLAKE-YARD AT GLOUCESTER, MASSACHUSETTS.

coast the direction of the wind has considerable influence on the drying. Winds from the northwest or southeast are usually dry and good for curing fish, but under the influence of southwest winds the fish are liable to burn, and when northeast winds prevail it is extremely difficult to dry the fish.

Much difference exists in the extent to which the fish are dried. Some are dried for only a few hours and others for a week or more, depending on the market for which they are intended. Some markets desire fish from which 50 per cent of moisture has been eliminated; others 60 per cent, and others 70 per cent, and since a larger per cent of moisture removed represents a greater increase in labor and decrease in weight of product, a curer endeavors to avoid drying them any more than necessary. Those to be used in preparing boneless fish are dried very slightly, 8 or 10 hours of good sunning being sufficient, while the export fish must be dried for a week or 10 days. Every evening the fish are placed, flesh side down, on the flakes, in small heaps of 15 or 20, and a cover of wood, known as the flake box, is placed over each heap to prevent injury from dampness or rain. This cover consists of a rectangular box with a peaked roof and is generally about 38 inches long, 22 inches wide, and 14 inches high, the whole being made of three-fourths inch rough boards. When the air is moist, the fish are not spread out, but if the weather renders it necessary to keep the fish piled up for several days, they are occasionally rearranged.

When preparing fish for export, after they have been on the flakes two or three days they are placed in kenches under cover to "sweat," where they remain for two or three days, when they are again spread on the flakes for a day or two. In some instances the fish are then dry enough for shipping, but usually it is necessary to sweat them once more and again dry them for a day or so. The export fish are usually dried sufficiently hard to withstand the pressure of the thumb in the thick part of the flesh without retaining the impression. During moist weather these fish are likely to sweat and become soft; it is then necessary to "throw them," scattering them over the flakes for a day or so.

Most of the export fish are what are known technically as "kench-cured." This differs from the above only in that the salted fish on removal from the vessel's hold are not placed in butts, but in kenches, skin down, in the warehouse, whence they are removed as required, washed to remove slime, undissolved salt, etc., and dried on the flakes for three or four days in the manner last described. They are next repiled and sweated for two or three days, when they are dried again for a day or two, repiled and sweated for two or three days, and again dried for a day or two, when they are ready for shipment. These fish are slack-salted, but well dried, whereas fish for the domestic trade are generally heavily salted, but only slightly dried. Hake and haddock are rarely kench-cured, but the latter are not often exported from the United States, although there is a steadily increasing exportation of them from Nova Scotia to southern Brazil and to Cuba.

In case the fish are fresh when received at the curing-houses, they are at once beheaded, eviscerated, split, and washed in the manner described for vessels fishing on the Grand Banks. They are immediately placed in butts, with the flesh side up and with about 7 bushels of salt to 1,000 pounds of fish scattered among them. The fish are piled in each butt until they extend a foot or two above the surface. On the second or third day, after they have settled somewhat, a half bushel of salt is placed on top. No pickle is added, as in case of Grand Banks fish, since the green fish will

make their own pickle. The fish remain in these butts at least fifteen or twenty days, and as much longer as desirable, when they are removed, water-horsed, and dried on the flakes, as already described. This is the true "pickle-cured" fish, the treatment of the Grand Banks fish combining both the "kench cure" and the "pickle cure."

Pollock which have been salted only a few days on the vessel are sometimes placed in the butts and weak pickle is allowed to percolate through a basket of salt over them for five to seven hours. Or, if fresh, they are split, washed and kenched, skin down, with 1 or 2 bushels of salt to the 1,000 pounds of fish, and on the following morning they are placed in butts, back up, each butt being filled with weak brine, which leaks through a basket suspended over it. On removal from the butts the fish are water-horsed over night and exposed on the flakes, back or skin side up, for three or four days. By exposing them with the face down the danger of sunburning is removed and flies are less apt to injure them. Pollock cured in this manner are always shipped whole for domestic trade and will keep for only a few weeks.

In the vicinity of Jonesport, Me., a cure somewhat similar to the stockfish is applied to haddock, except that the fish are first lightly corned. The method is simple; the heads and viscera are removed, the bellies cut off, and the fish lightly corned for a few hours. They are then tied together by the tails and suspended over a pole or fence to dry, becoming quite hard and solid within a week or two. Small fish are used, the average weight when dried being from 1 to 2 pounds, and the product, which is very palatable, is entirely for local use. About 4,000 pounds of haddock are annually prepared in this manner at Jonesport, yielding 1,300 pounds of "clubbed haddock," worth $125.

Dunfish is prepared in such a manner that the resulting article has a dun or brownish color. It is of superior quality and is designed especially for use on the table uncooked. The manner of curing is somewhat lengthy, and it requires much more care than curers ordinarily are willing to give to the preparation of fish for market. The fish are usually caught in the winter or spring, and immediately after being landed are split and slack-salted, and then laid in piles for two or three months in a dark storeroom, covered for the greater part of the time with salt hay or eel-grass and pressed with weights. At the end of that time they are dried for a few days in the open air and are again compactly piled in a dark room in the same manner as before, for two or three months, when they are dried for two or three days and are ready for market. The process of preparing dunfish made the Isle of Shoals quite noted a century ago, but has fallen into disuse, though some is prepared there each year.

Drake, in Nooks and Corners of New England, says:

> The "dun" or winter fish, formerly cured here, were larger and thicker than the summer fish. Great pains were taken in drying them, the fishermen often covering the "fagots" with bedquilts to keep them clean. Being curĕd in cold weather, they required but little salt, and were almost transparent when held up to the light. These fish sometimes weighed 100 pounds or more. The dunfish were of great esteem in Spain and in the Mediterranean ports, bringing the highest prices during Lent. They found their way to Madrid, where many a platter, smoking hot, has doubtless graced the table of the Escurial. In 1745 a quintal would sell for a guinea.

The foregoing are the principal features in the curing of codfish on the New England coast. The amount of salt required, the time for exposing the fish, the length of the exposure, and so forth, are points which demand practical knowledge

ESTABLISHMENT FOR PREPARING AND HANDLING DRIED CODFISH AT GLOUCESTER, MASSACHUSETTS.

obtainable only through long experience. The process of curing hake, haddock, cusk, and pollock, except as above noted, differs in no particular from that applied to cod. They are dressed and split in exactly the same manner and require about the same amount of salting and similar treatment in every particular. Hake are not so likely to sunburn as cod and need not be protected from the sun. Pollock turn somewhat dark, and for that reason are not popular, but among connoisseurs are highly esteemed, especially when slack-salted.

The loss in weight in dressing and curing cod and other ground fish for the domestic market ranges from 50 to 65 per cent, according to the species, the season of the year, and the extent of the salting and drying. The loss is greatest in case of haddock and cod and least in curing cusk and hake. Generally, large fish decrease more than small ones and large Shore decrease more than large Georges. From a number of records made during different seasons, the following summary is obtained, showing the average quantity of each kind of fish required to make a gross quintal (114 pounds) of dried fish suited for the New England markets:

Species	Pounds required to make a quintal cured.		
	Round.	From the knife.	From the butt.
	Pounds.	*Pounds.*	*Pounds.*
Haddock	299	206	133
Cod	288	193	131
Pollock	280	184	130
Hake	258	190	131
Cusk	246	178	132

Fresh split cod ready for curing contains about 80 per cent of water and $1\frac{1}{4}$ per cent of salt. A large percentage of this water is withdrawn by salting, some by drying, and a much smaller quantity by compression, the latter process also removing a small quantity of the salt in the form of pickle. The resulting product, when prepared for the domestic trade, contains about 51 per cent of water and $19\frac{1}{2}$ per cent of salt. The stockfish of Norway contains about 17 per cent of water and $1\frac{1}{2}$ per cent of salt. 100 pounds of cod, as they come from the water, will weigh about 66.9 pounds, dressed ready for salting, of which about 53 pounds represent water and 1 pound represents the weight of salt. The process of curing for domestic trade adds about 6.2 pounds of salt and removes about 34.1 pounds of water, of which 31.1 pounds are removed by the salting and 3 pounds by the pressing and drying. This results in 38.8 pounds of dry-salted fish, of which 18.9 pounds represents water and 7.2 pounds salt. By continuing the drying process and removing more water the keeping qualities of the fish are improved, but since it decreases the quality of the flavor as well as the weight of the fish, and adds to the cost of curing, it is not desirable, unless the fish are to be shipped to a warm climate and held there for a long time. To make a quintal of domestic-cured codfish requires 193 pounds of split fish or 288 pounds of round fish, whereas to make an equal quantity of fish suitable for export to Brazil requires about 350 pounds split, and for 114 pounds of Norway stockfish about 474 pounds of split fish or 708 pounds of round fish are required.

The cost of the labor, salt, etc., varies in accordance with the fish being handled, the condition of the weather, the amount of drying required, the facilities for handling the fish, etc., but generally runs from 38 to 50 cents per quintal, of which 15 to

18 cents represents the cost of the salt. It usually costs more to cure fish in July and August than in October, because of the greater difficulty in drying and consequently the increase in number of times that the fish have to be handled. An examination of a number of itemized accounts shows the average cost of handling cod from the round to the cured product to be 43 cents per quintal; haddock, 46 cents; hake, 40 cents; pollock, 43 cents; cusk, 43 cents. If the fish have been salted on the vessel the cost of handling ashore will be reduced by the labor required for dressing, splitting, and salting, and by the decrease in amount of salt used, and ranges between 28 and 38 cents per quintal. When green split cod costs $1\frac{3}{4}$ cents per pound, a quantity sufficient to make a quintal gross (114 pounds) would cost $3.84, and the cost of handling averaging 43 cents per quintal, it is necessary to sell the cured product at $4.27 per quintal gross to clear expenses. This cost of labor is so small, compared with the original cost of the fish, that it pays to take the utmost care in the process of curing.

The principal grades of dry fish are Georges cod, Shore cod, Grand Banks cod, hake, cusk, haddock, and pollock. Each grade of cod is further divided into large, medium, and small. Georges cod are generally the largest and choicest received, and are taken on Georges Bank, South Channel, Browns Bank, and adjacent fishing-grounds. These fish are usually heavily salted and dried only a day or so. The Grand Banks cod or "Bank cod" are taken on Grand and Western banks and Banquereau and are usually dried longer than the Georges or Shore cod. During recent years cusk have been divided into two grades, large and small, the former comprising all over 19 inches in length as received from the vessel. The prices of codfish vary according to the conditions in which they are sold, and probably the best guide to the comparative values of the different species may be obtained from an examination of the prices received as they are landed from the vessels.

The following shows the prices per quintal of the principal grades of salt fish on the Boston and Gloucester markets in January, April, July, and October, 1898:

Designation.	January.	April.	July.	October.
Georges cod, large	$6.25	$5.50 to $5.75	$5.50	$5.75 to $6.00
Georges cod, medium	4.00	4.00	3.75	3.50 to 3.75
Shore cod, large	5.00 to $5.25	5.00 to 5.25	4.50	4.50
Shore cod, medium	3.50	3.50	3.00	3.00 to 3.25
Bank cod, large	4.00 to 4.25	4.00 to 4.25	4.00 to $4.25	4.00 to 4.25
Bank cod, medium	3.50	3.50	3.25 to 3.50	3.50 to 3.75
Hake	2.25 to 2.37½	2.25 to 2.50	2.00 to 2.25	1.75 to 2.00
Haddock	2.50	2.00 to 2.25	2.00 to 2.25	2.00 to 2.25
Cusk	3.50	3.50	3.25 to 3.50	3.50 to 3.62½
Pollock	2.75 to 3.00	2.75	2.75 to 3.00	2.50 to 3.00

For the local market or nearby trade the whole fish are packed in rough bundles of one quintal, or 112 pounds, each, and tied with cords, or in wooden boxes holding from 100 to 450 pounds each. The 450-pound boxes are 46 inches long, 22 inches wide, and 16 inches deep, inside measurement. At Gloucester, Boston, Vinal Haven, and Portland large quantities are prepared as boneless cod (see pp. 400-405). In packing for export trade the fish are placed principally in drums made of birch staves, with ends of pine and 8 hoops on each drum, and with capacity for 1, 2, 4, or 8 quintals, tightly compressed.

The curing of codfish on the Pacific coast of the United States began in 1864 and has been continued with more or less success up to the present time, the annual yield

now amounting to over 5,000,000 pounds, at an average value of about $3\frac{1}{2}$ cents per pound, most of the catch being made by vessels sailing from San Francisco and operating in Bering Sea or at fishing stations on the islands bordering that sea. The methods pursued in the curing are not dissimilar to those in vogue on the New England coast. A small percentage are marketed hard-dried with the skin on and the bones left in, being tied up in bundles of 75 to 100 pounds; but most of them are prepared as boneless fish after their receipt at San Francisco. The product is marketed throughout the Pacific coast and exported to Australia, the Hawaiian Islands, and the Orient. According to Mr. Wilcox, Pacific coast boneless codfish has been most favorably received in Australia, where it has nearly driven the hard-cured stockfish of northern Europe from the market. Large quantities of dried codfish from New England are shipped to the Pacific coast, especially to San Francisco.

REDDENING OF SALTED CODFISH.

Considerable trouble and loss have resulted to the dried codfish trade from the tendency of the prepared fish to turn red some time after it has been dried. It is especially noticeable with fish that have remained in the hold of the vessel for a long time, and occurs but to a limited extent with fish brought in on ice and then cured. It is attributed to various causes, among which are the removal of the gluten by pressure and the oil becoming partly rancid through age, but the most generally accepted theory is that it is due to vegetable organisms in the salt, especially in that produced by the evaporation of sea water by solar heat.

At the instance of the United States Fish Commission, in 1878, Prof. W. G. Farlow, of Harvard University, made an investigation of the cause of this color and the means of remedying it. He attributed the trouble to a minute plant (*Clathrocystis roseo-persicina*), consisting of minute cells filled with red coloring matter. This plant was found on the floors and walls of the packing houses, and also in the holds of some of the vessels. It exists to a considerable extent in Cadiz salt, but not in Trapani salt, and when the latter is used the discoloration is not so likely to result. Consequently Trapani salt has almost entirely superseded the use of Cadiz salt in curing codfish. But even when Trapani salt is used the fish is likely to turn red, and in order to destroy the organisms the buildings are usually whitewashed inside as well as outside at least once a year. To overcome this difficulty it has been recommended that boracic acid be added to the pickle in the proportion of not less than 3 per cent of the water used.

With the view to counteract this reddish tendency in cured fish, a method was patented* in 1883 by R. S. Jennings, of Baltimore, Md., by which the salted fish is subjected to the action of superheated steam or hot air to destroy the organic life in the salt with which the fish have been cured. He employed an endless woven-wire apron hung on rollers and having within it a narrow box or pipe with a perforated top. Into this box or pipe air or steam heated to a temperature of 400° or 450° F. is forced and discharged from it against the fish placed on the endless apron, the apron being revolved at such speed as will expose each fish to the action of the heat for about two seconds. It is claimed that by this method the exterior of the fish is heated sufficiently to destroy the germs without injuring the appearance or qualities of the fish, but the process has never been adopted by the trade.

* See Letters Patent No. 273074, dated February 27, 1883.

Many curers endeavor to prevent this redness by sprinkling a small quantity of boracic acid and common salt over the fish. About 1 pound of the acid is used to 40 pounds of fish. This article was introduced in the codfish business about 1881 and is now quite generally used, particularly during the warm months, when it is found almost essential in order to keep dry fish in good condition for a few weeks or even days. It is generally employed in the form of a proprietary compound.

In discussing the cause of the discoloration of Pacific coast codfish a prominent fish-curer of New England states:

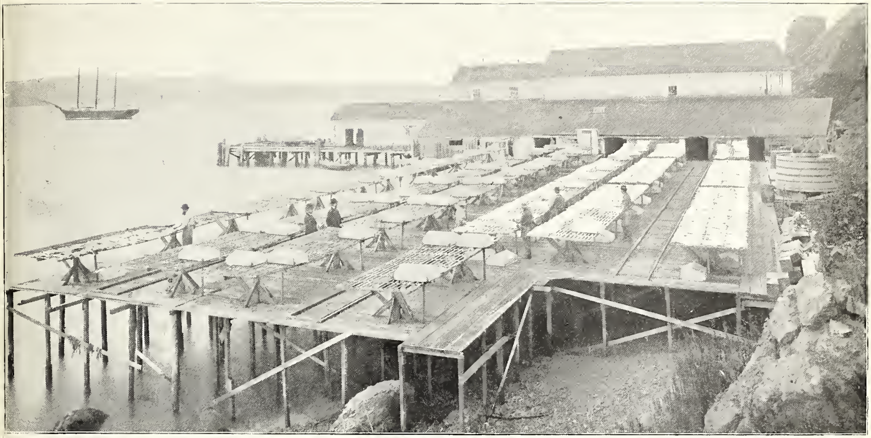
The Alaska codfish turn off-color for precisely the same reasou that our Graud Banks codfish do, when caught on long trips. The fish are piled very high in kenches, and the pressure of the upper tiers of fish crushes the fibers and sacs between the fibers and all the white gluteu is pressed out. In a nutshell, the cause of codfish turning yellow is pressure. Our Georges codfish are caught by vessels which are very seldom out over a month, and a fare of 30,000 pounds in that time is considered a good catch. These fish are all caught with hand lines. They are never piled high in the kenches, as there is no need of it, for there is plenty of room in the vessel for 30,000 pounds without piling them high, and so they are put iuto very shallow kenches. They hold their weight, which is a saving to the fishermen, and they hold their color simply because the fibers and sacs which hold the white gluten are never crushed. Our Grand Bauks fleet are gone from Gloucester all the way from two to four months, and if they have hard luck are sometimes gone six months. If one of them comes in with a full fare in two months, her fish will be very much whiter ou the average than one that has been out twice or three times as long. The fish may be piled up to the deck of the vessel and the fish in the lower part of the kenches may be pressed very hard and the fibers and sacs crushed aud then fish will turn yellow; but if she stays out twice or three times as long they will be yellower still, because they have been pressed so much longer. But the greater part of her fish, viz, the latest ones that she caught and the tops of the kenches, will be white. The nearer the top the whiter the fish; the nearer the bottom the yellower the fish, and all due entirely to the amount of pressure they have received. I understand that the vessels that fish on the Alaska fishing-grounds are very large vessels, brigs, or barks, and they fish six months and bring in fares of half a million pounds or more and they are pressed too much. The only way that Alaska codfish can be made to hold their color is to send smaller vessels and bring smaller fares. The smaller the fare, if caught quickly, the whiter the fish. The longer the trip and the larger the fare, the yellower the fish. If you will examine transverse sections of Georges codfish and Grand Banks codfish from the top to the bottom of the kenches with a microscope you will notice that the fibers of the Georges are full of white gluten while those of the Bank codfish are crushed and flattened down, and there will be a variation in the fish according to the part of the kench they come out of. Grand Banks codfish and Alaskan, I think, are caught on trawls and they struggle on the bottom; while they are worrying ou the hook and struggling to escape, the blood settles in against the skin. They may be very white on the face for all that, if they are well washed and soaked before salting.

PREPARATION OF BONELESS CODFISH.

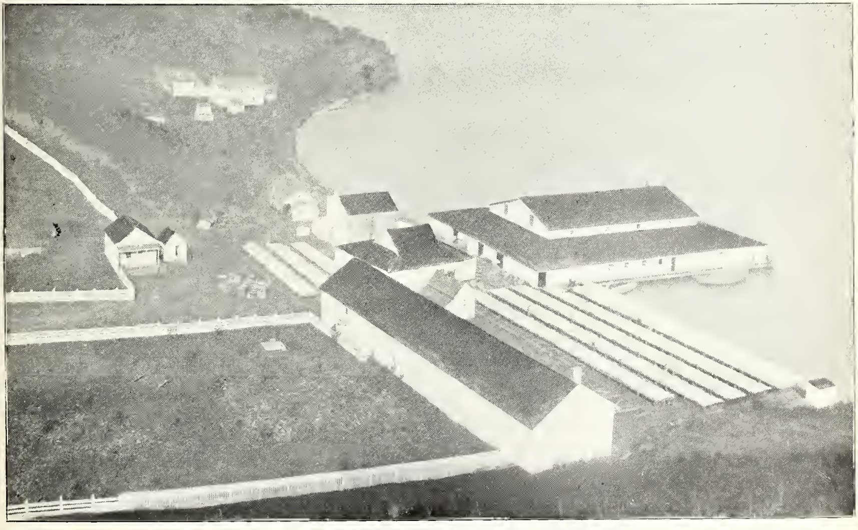
The preparation of boneless codfish is doubtless the most important development in the handling of dried fish during the present century. For several years prior to 1870 the need was felt of some method of packing dried fish in neat packages of small but definite weight. A number of processes were devised and patented, but very few of them were found of practical value.

In 1868 William D. Cutler, of Philadelphia, Pa., patented* a process by which the fish were divested of skins and bones and run through a machine adapted to grinding, so as to thoroughly disintegrate the fiber of the fish, and if very fat and oily the disintegrated mass was then subjected to pressure to remove the superabundance of oil. It was then spread upon metal, stone, or other suitable surface, heated by means

* Letters Patent No. 81987, dated September 8, 1868.



CODFISH STATION AT PESCADA, CALIFORNIA.



CODFISH STATION AT CALIFORNIA CITY, CALIFORNIA.

of steam pipes passing beneath the slabs, where it remained until thoroughly dry, probably from ½ to 3 hours, when it was placed in close paper or wooden boxes, each containing 1 pound or other suitable quantity. The product was somewhat similar to the article prepared in Norway from stockfish and sold as "fish meal." Several thousand pounds of codfish were prepared in this manner and sold under the name "desiccated fish." This method was expensive, and the article lacked preservative qualities, being affected by atmospheric conditions to such an extent as to impair its food qualities; yet while the process extended little beyond the experimental stages, it was sufficient to attract the general notice of the trade and encourage the invention of methods of preparing a similar article.

A few months later Elisha Crowell, of New York City, invented* a process that differs little from the present method of preparing boneless codfish.

The following description is given by Mr. Crowell:

> The object of this invention is to so prepare cod and other fish that it shall be divested of everything not edible which unnecessarily adds to its weight and bulk, and shall be reduced to the most convenient form for handling and transportation, while at the same time it is sufficiently protected from the action of the air. The usual method of preparing such fish heretofore employed consists simply in salting and drying the fish in large pieces, each piece being generally one-half or the whole of a fish. In this condition it can not be conveniently packed in small boxes, and is therefore exposed to atmospheric influences which injure its quality and taste. From the same cause it is not in a convenient condition for transportation or handling, and the refuse portions add unnecessarily to its weight, while also deteriorating the quality of the article as an article of sale and common use. To obviate these disadvantages one manufacturer has ground up the fish, but when treated thus the air reaches directly every fiber of the fish and soon destroys its taste, besides drying it up to such a degree that it becomes hard and "stringy" and after a time almost unfit for use. It can also be easily adulterated, either with foreign substances or with the ground skin and bones or fish improperly cured. In order to overcome all these disadvantages and produce an article which shall possess and retain all the delicate flavor of the codfish, while entirely clear of useless matter, and in the most convenient possible condition for transportation, I remove the bones and skin, either before or after salting, and then cut up the fish into long, narrow strips. These strips I expose to the drying action of a current of air either naturally or artificially induced, so as to remove the moisture from the fish sufficiently for its preservation. The fish may be cut up or stripped still more between one drying operation and the next. Salt is not usually applied during the operation. The strips thus produced are then cut into suitable lengths and packed in boxes, kegs, or barrels to exclude the atmospheric influences as far as possible. The retailer can pack the article in small boxes containing half a pound or a pound, etc., for the convenience of himself and his customers.

In 1869 Benjamin F. Stephens, of Brooklyn, N. Y., patented† a modification of the process invented by William D. Cutler during the preceding year, this being a saturation of the compressed and granulated fish with glycerin to keep it moist and prevent extreme dryness. During the same year Joseph Nickerson, of Boothbay, Me., introduced a somewhat similar process,‡ consisting in removing the skins, bones, etc., from the salted fish, reducing the flesh to a granulated state, and then steeping it in brine until every particle of the mass was completely penetrated by the brine, after which it was pressed into molds, the pressure serving the double purpose of forcing out all surplus moisture and reducing the fish to hardened cakes of convenient size. Neither of these two processes has ever been used to any noticeable extent.

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* Letters Patent No. 84801, dated December 8, 1868.
† Letters Patent No. 87986, dated March 16, 1869.
‡ Letters Patent No. 88064, dated March 23, 1869.

A somewhat novel idea is set forth in Letters Patent No. 90334, granted on May 25, 1869, to John Atwood, of Provincetown, Mass. He states:

> The object of my invention is to produce a wholesome article of food in the nature of prepared fish that shall be reasonable in price, convenient for cooking, and free from offensive odor. The old method of drying fish is well known, and is open to many apparent objections. The new method of preparing fish by desiccation is so expensive as to make the price of the article to consumers a serious objection to the method. The cause of ordinarily cured fish having an offensive odor at all times, but more especially when the atmosphere is moist, is the mucous membrane between the skin and the flesh, which, when dried and afterwards moistened, becomes slimy and offensive. This is peculiar to the old method of curing and bundling fish. My method of preparing fish, which is particularly applicable to cod and haddock, is as follows: When the fish is fresh I take out the principal bones and fins, the fish remaining whole or split in halves. When partially dried or cured with salt I remove the skin, and with it the entire mucous membrane, the cause of the offensive odor of salt fish. I then pack in light wooden boxes of convenient size—for instance, from 10 to 100 pound boxes. Fish prepared after this method is white, clean, and sweet, and will keep for any length of time. It will not dry up and lose its flavor like the desiccated article, but remains moist and keeps the palatable flavor of freshly cured fish. It can be freshened for the table in a few minutes, and can be brought on whole, as it is often desired to do so. This can not be done by fish cured by the old method, nor by any other modern process.

It appears that these numerous patents were obtained all within a period of nine months, and it is claimed that about the same time other persons prepared dried fish, stripped of skins and bones and packed in small boxes, without applying for patents. At first only the inferior grades of fish were used, but as the new article met with a ready sale greater attention was given to the quality of the preparation. In 1870 three fish-dealers in Gloucester prepared this article, besides several concerns in other parts of New England. The trade increased considerably, and in 1875 over 500,000 pounds of boneless fish were prepared in Gloucester alone. Nearly all of these fish were prepared in a manner somewhat similar to that of Elisha Crowell, and at first the preparers paid a royalty to him. Becoming dissatisfied with certain discriminations made by Crowell in favor of particular firms, several dealers in Boston successfully contested his right to the royalty. Almost immediately the business assumed large proportions, and in 1879 about 12,000,000 pounds of boneless fish were prepared in Gloucester, and over 6,000,000 pounds in other New England ports, giving employment to nearly 400 persons. At present the output of boneless cod amounts to about 25,000,000 pounds annually, most of which is prepared in Gloucester, the remainder being put up at Boston, Provincetown, Portland, Vinalhaven, etc.

The general process of preparing boneless fish is as follows: From the flake yard the dried fish go to the "skinning loft." In skinning, each fish is placed flesh side down on the skinning board, consisting of a soft pine block about 30 inches long, 20 inches wide, and 2 or 3 inches thick, or of an inch pine board of similar length and width resting on two end supports. The dorsal, anal, and ventral fins are first cut away with a knife much like a splitting knife; then grasping the skin at the napes the workman strips it off, usually in two pieces. The nape bone is sometimes torn out in the operation of removing the skin, but generally it is removed with a small iron gaff called a "bone hooker," which is about 8 inches long, with a curved shank and sharp point. The workman then turns the fish flesh up and cutting under the lower end of backbone or tail bone removes it. The dark membrane is then torn from the napes and any dark portion of the flesh cut away. Sometimes in dressing very choice fish a workman removes all the ribs and other small bones, making what is known as "absolutely boneless" fish. And in boning hake and other small and cheap fish the

tail bone is frequently left in, and sometimes the nape bones also, this being known as "dressed fish." Hake and haddock are the easiest fish to prepare, and cusk are the most difficult. The cost of skinning and boning ranges from 25 to 40 cents per 100 pounds of prepared fish, depending on the class of fish handled.

The ordinary knives for cutting boneless fish have hook-tipped blades from 6 to 7 inches in length, with white-pine handles. For cutting cusk, which have tough bones and skins, a special knife is required, called a "cusk-bone knife," the blade of which is of finely tempered steel, about $1\frac{3}{4}$ inches long, $\frac{3}{4}$ inch wide, and $\frac{1}{16}$ inch thick at the back, with a square end. The handle is about $4\frac{1}{2}$ inches long by $1\frac{1}{2}$ inches thick at the butt, tapering to a point at the blade end.

The following summary shows the result (in pounds) from skinning and boning a quintal of the various grades of fish:

Condition.	Large Georges Cod.	Large Bank or Shore Cod.	Small Georges Cod.	Small Bank or Shore Cod.	Haddock.	Hake.	Cusk.	Pollock.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tail and nape bones in	96	95	91	90	90	91	....	97
Tail bone in, nape bones out	93	92	85	85	82	85	....	94
Tail and nape bones out	88	87	83	82	78	82	82	....

After being skinned and boned the fish are sprinkled with an antiseptic powder composed principally of boracic acid and chloride of sodium or common salt, and placed in many sizes and styles of packages, containing from 500 pounds down to 2 pounds. The boxes are made of spruce or pine, and the small ones, 5 pounds and under, usually have a sliding cover. The most popular sizes are 40 and 60 pound boxes, the dimensions of the former being usually 20 inches by 12 inches by 5 inches, inside measurement, and of the latter 20 inches by 12 inches by 8 inches, inside. In the larger-size boxes the fish are usually placed without being cut. A neat way is to place two halves together, as in the round fish. Others are loosely rolled and placed with the shoulders at the ends of the box and the tails overlapping, and choice Georges fish look very nice in that manner. Frequently when packed in the 40 or 60 pound boxes each individual fish is cut transversely the width of the box and folded over itself. Thick fish are sometimes cut transversely and each piece split and folded over in such a manner that the clean cut appears outside. The fish are also sometimes cut transversely across the fiber, and tightly packed in boxes with the fiber running perpendicularly. In the small boxes the fish must of course be cut in much smaller pieces. The 5-pound boxes usually measure 10 inches by 8 inches by 4 inches.

During the past fifteen years the packing of boneless codfish in 1-pound and 2-pound "bricks" has become very popular. The skinned and boned fish are cut into small pieces 6 inches long and 3 inches wide, as nearly as practicable, the cutting being done either by hand, by treadknives, or by special machinery. Two pounds weight of these are carefully placed in press compartments 6 inches long by 3 inches wide and $3\frac{1}{2}$ inches deep, care being taken to have choice square pieces at the bottom and at the top, and either two or four strings of cotton twine are run through slits in the compartment, so as to pass under and around the brick of fish. The fish are then tightly compressed for a few moments, and on removing the compression the strings are tied and the brick is removed. Many forms of presses are employed, the most usual consisting of a sliding box having two or three compartments, each of the size

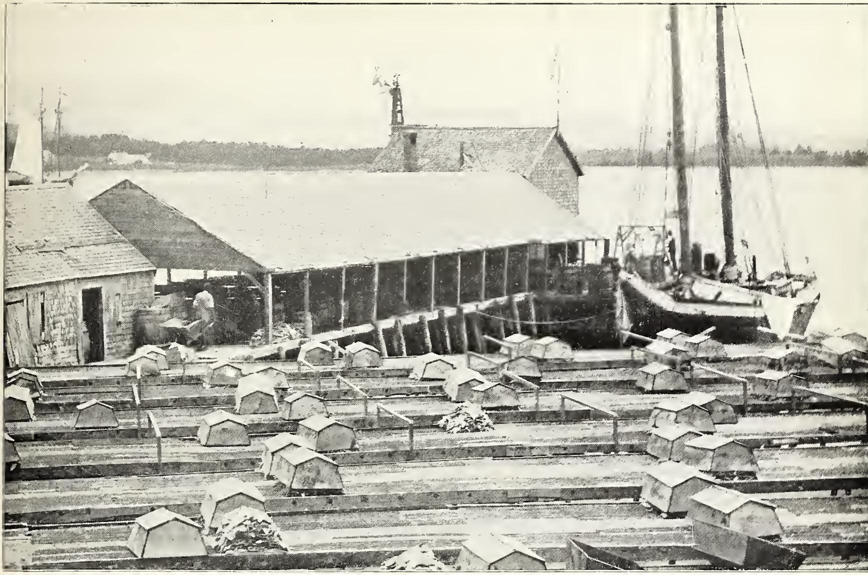
noted, and so arranged that a hand or foot lever forces a block down in one compartment at a time. The pressure remains while the fish are being placed in the second compartment, and when it is released the box is slid along until the second compartment comes under the press, when the brick is removed. When 1-pound bricks are desired, the 2-pound packages are cut in half. The bricks are then sprinkled with antiseptic powder, wrapped in parchment or waxed paper, and placed in the packing boxes.

A pound of parchment, costing 14 cents, contains about 172 sheets of the size necessary for 1-pound bricks, and 113 sheets of the size necessary for 2-pound bricks, thus making it cost 8.14 cents to wrap 100 pounds of the former and 6.2 cents for 100 pounds of the latter size. One ream, or 4 pounds, of waxed paper for 1-pound bricks costs 30 cents, and 1 ream for 2-pound bricks costs 40 cents, making the cost of using wax paper 6.2 and 4.2 cents, respectively, for 100 pounds of 1 and 2 pound bricks.

Cutting into bricks was greatly facilitated in 1885 by providing a cutting board with pins at stated intervals to hold the fish when pressed down by hand, and with two sets of parallel grooves at right angles to each other cut into the board sufficiently deep to give direction to a knife which is drawn through the fish, these longitudinal and transverse grooves being separated by uniform distances conforming to the size of the bricks. In 1886 a somewhat intricate machine* was introduced at Gloucester for this purpose, and is now used in one or two of the establishments. It consists of a large rotating drum, the surface of which is provided with pins which enter the fish placed thereon and thereby hold them in position. On this the fish are fed, and the drum revolves intermittently, and at regular intervals a knife located above and parallel with its axis descends to cut the fish transversely, the drum rotating intermittently to permit the knife to cut the fish without being crowded by them. These strips of fish are then carried forward by the drum beneath a series of rotary knives mounted upon a shaft, the axis of rotation of which is parallel with the axis of rotation of the drum, the strips being thereby severed into blocks. The length of the bricks is determined by the distance covered by the fish between each descent of the vertical knife, and the distance between the rotary knives determines their width. The pieces of fish are then carried forward beyond the rotary knives and are removed from the pegs by suitable strips or rods entering grooves in the surface of the drum and thus coming between it and the blocks of fish.

A few months thereafter another machine† was introduced for the same purpose, but was never extensively used. This consisted of two revolving drums carrying a platform made in sections with longitudinal grooves, having small pegs in its surface to hold the fish placed upon it, skin side down, and so revolving as to press the fish against circular knives placed at suitable distances apart. The knives were rotated by the motion of the fish, and the latter were cut into longitudinal strips equal in width to the distance between the knives. As these strips passed beyond the knives they were raised off the pins and the platform by rods entering between the strips and the surface of the endless platform. A quantity of fish having been thus cut into longitudinal strips, they were returned to the front end of the machine and by means of a guide were again placed on the movable platform so as to approach the rotating knives at right angles, and as they passed under were cut transversely, forming rectangular blocks. The circular knives were so arranged that alternate ones might

* See Letters Patent No. 346871, dated August 3, 1886, in favor of J. L. Shute and W. O. Taylor.
† See Letters Patent No. 356725, dated January 25, 1887, in favor of Walter S. Moses.



CODFISH STATION AT SOUTHWEST HARBOR, MAINE.

INTERIOR OF BONELESS-FISH LOFT AT GLOUCESTER, MASSACHUSETTS.

be easily raised for the second cutting, making the length of the blocks of fish double their width.

During 1885 a machine* was devised for splitting or cutting these blocks horizontally, so as to provide suitable layers for the tops and bottoms of the bricks and to give a smooth, regular appearance more acceptable to the trade. This consisted of an endless belt adapted to hold and carry the blocks of fish to an endless cutting ribbon traveling parallel to and an inch or so over the belt, but it was not found sufficiently practical for general use.

The cost of preparing and packing boneless cod in 1-pound bricks is about $2 per 100 pounds, aside from the cost of the cured fish, apportioned as follows: Skinning and cutting, 30 cents; labor at press, 32 cents; wrapping paper, 6 cents; antiseptic powder, 10 cents; boxes, 65 cents; labor for cutting, powdering, and wrapping, 10 cents; miscellaneous labor, 10 cents, and plant and superintendence, 37 cents. The refuse skins and bones are used in the preparation of fish glue and fertilizer, and their sale constitutes an item of considerable importance.

It is stated that of the total quantity of boneless fish, an average of 60 per cent is prepared from cod, 28 per cent from hake, 8 per cent from haddock, and 4 per cent from cusk. Pollock are sometimes prepared as boneless fish, but the flesh is rather dark for this purpose.

During the past six or eight years dried fish have been disintegrated and placed on the market under a number of trade names, such as "desiccated codfish," "fibered codfish," "flaked codfish," and "skriggled codfish." In preparing these specialties the fish are dried somewhat more than in case of boneless fish and all the bones are removed, a quintal of fish as it leaves the butts making about 60 pounds of dried fish for this purpose. By means of a disintegrating or shredding machine the fibers of the flesh are thoroughly separated, giving it the appearance of fine wool. This is spread out under cover an inch or two deep on a platform table for further drying, all dark portions being picked out in the meantime. It is then placed in small pasteboard boxes, usually coated with a varnish of rosin or paraffin and sometimes lined with waxed paper or parchment, each box holding usually half a pound. This product is especially desirable for fish balls and creamed codfish.

In 1885 a process† was introduced by which the disintegrated codfish was subjected to the action of hot water and then formed into cakes or blocks under pressure, in the following manner:

Take cured or salted fish, remove the skin and the bones thoroughly, and then disintegrate the flesh by shredding, grinding, or some other convenient way of reducing it to small pieces. When in this condition, apply heated water to it, and immediately thereafter submit it to sufficient pressure in molds to expel the water and compact the fish and press the small pieces closely together, thereby forming the mass into cakes or blocks, the size of which can be regulated as desired, from 1 pound upward, by the size of the molds employed. Subjecting the disintegrated fish to the action of hot water sufficiently dissolves the gelatin in the fibers to cause the small pieces of flesh to adhere to one another when they are firmly pressed together. Water heated to any temperature above 100° will produce the result, and even steam may be used; but it has been found that the most successful and satisfactory results are obtained by the use of water heated to a temperature between 120° and 200°. If steam is used, the fish will be partially cooked thereby, which should be avoided.

It is claimed that when fish has been treated and prepared in this manner, the salt will not collect upon the outside of the cakes or blocks, as it does upon salt fish prepared by the methods in general use, and that the fish will not become discolored.

* See Letters Patent No. 317469, dated May 5, 1885, in favor of Walter S. Moses and Oscar Andrews.
† See Letters Patent No. 326099, dated September 15, 1885.

FOREIGN CODFISH MARKETS.

The world's annual product of dried codfish now amounts to about 600,000,000 pounds, cured weight, the equivalent of 2,500,000,000 pounds of round fish, obtained principally by the fishermen of Norway, Newfoundland, Canada, United States, and France. The chief markets are France, Spain, Portugal, Italy, and Brazil. In 1893 France imported 94,218,948 pounds of codfish, valued at $4,949,037, without counting the large quantity cured by fishermen of that country. During the same year Spain imported 97,811,488 pounds, worth $4,795,278, and Portugal, 43,126,385 pounds, worth $1,789,560. The imports into southern Europe are principally from Norway and Newfoundland; those into Brazil and other South American countries are largely from Newfoundland, and the West India trade is almost monopolized by shipments from Canada. While a steadily increasing export trade has been conducted by Norway, Newfoundland, and Canada, especially with the West Indies and Central and South America, the exports from the United States have very greatly decreased.

A hundred years ago our exports of cod approximated 500,000 quintals annually, at an average value of $4.50 per quintal. In 1804 the exports were 567,825 quintals, worth $2,400,000, the largest quantity ever exported from this country in any one year. The annual exports decreased to about 300,000 quintals during the ten years following the war of 1812, and since that time up to the present they have approximated about 130,000 quintals annually. The exports during the ten years ending June 30, 1894, averaged 16,260,008 pounds, worth $737,084, annually, or 20 per cent of the total quantity cured. Over half of these were sent to Haiti, and much smaller quantities went to Cuba, Dutch and French Guianas, Colombia, Santo Domingo, Jamaica, and various other countries, and especially to ports in the West Indies and South America.

It thus appears that at present this country has only a small share of the trade in the principal codfish markets. Brazil, for instance, consumes about 500,000 quintals of fish annually, of which the United States supplies less than 2 per cent; and none whatever are sent from this country to the Catholic countries of southern Europe, the great fish-markets of the world. A century ago a large part of that trade was controlled by the United States, but since the domestic market will receive fish containing 50 per cent of moisture, while the Brazilian trade requires fish containing less than 25 per cent, greater profit has been found in supplying the home market, and nearly all the curers have contributed to that trade, resulting in a decrease in exports.

CODFISH CURING IN FOREIGN COUNTRIES.

In the British North American Provinces the codfish are cured in nearly the same manner as on the New England coast, except that they are dried much more thoroughly, and in many instances they are not salted in butts, but are spread on the flakes immediately after removal from the kenches. Each morning they are spread out, flesh side up, and at night they are gathered in piles of 15 or 20, with skin side up, and with the largest on top as a cover to the rest. If the sun becomes too hot during the middle of the day, they are turned with the flesh side down to prevent their being burned, but as soon as the great heat is over they are reexposed as before. When the fish are sufficiently dry, large piles are made, containing a ton or more, the whole being covered with birch bark and heavy stones, which serve to express much of the moisture then remaining. After compression for two or three weeks the fish are

placed in a dry warehouse awaiting a market. Before being shipped they are spread out on the gravel during one midday to extract any dampness they may have contracted in the warehouse.

For the purpose of comparison with our own methods the following notes on the methods of curing codfish in the principal European countries are presented, the notes being abridged by Adolph Nielsen from volume III of Norsk Fiskeritidende, Bergen, January and April, 1884:

NORWEGIAN METHOD.

As a rule the greater part of the codfish caught at Lofoden is left in salt from three weeks to two months, all according to how the fishery turns out, and how quick the vessels purchasing fish can succeed in getting a full cargo. After the fish are taken from the salt they are generally washed out at the beaches, close to the drying places, which, as a rule, consist of smooth and low rock, in the vicinity of the seaboard. In washing the fish woolen mittens are worn on the hands. After being carefully washed and the black membrane removed from the napes, the fish is put in small sloping heaps on the rocks for twenty-four hours, in order to allow the water to run off. In each heap are put from 6 to 8 fish, the undermost with the skin side turned down, the rest with the skin side up. As soon as the weather allows the fish to be spread, after being in the heaps twenty-four hours, it is carried up to the drying place and spread out, face up If the weather is fair and safe, the fish is left out the first night, but the skin side is in that case turned up toward evening. Next morning the fish is again turned, face up. After being left out the second day it is gathered together toward evening and put in heaps, 30 or 50 fish in each. The next morning it is spread again, and in the evening is put in a little larger heaps. When the fish has been spread two or three times it is stretched well, especially in the abdomen, before being put in heaps, in order to remove all the wrinkles and give the fish a smooth appearance. This work is considered to be of much importance in regard not only to appearance but also to the durability of the fish, because the dampness always gathers in those wrinkles and is very difficult to get removed entirely if not done away with in time. It is slow work, but they consider it better to devote one day to this than to go through it in a hurry in the evening when the fish are gathered in heaps for the night. Every time the fish are gathered in the evening in heaps these are made larger. After the fish has been spread three or four times, or when it is dry enough to stand pressing (which is noticed on the abdomen of the fish that crack when the fish is bent), it is put into the first pile for pressing. These piles are built round, and a small round peaked roof or cover of wood, about a foot larger in diameter than the pile of fish, is made to cover the piles with. On these roofs weights of stones are applied. These piles or pressing piles, as they generally are named, are built from 3 to 3½ feet high, the first time.

After the fish has remained in those piles from five to eight days, according as the fish was more or less dry when it was put in piles, it is piled over into another and larger pile in this way, that the undermost fish in this first pile is placed uppermost in the second, in which again the fish is left the same length of time as in the first one. If the weather after that time is suitable, the fish in these piles is spread every second day to dry, and for every time it is spread it is set in larger piles. If the weather is not suitable for spreading the fish, it is as often as possible piled over into new piles, in order to accelerate the cure and prevent the fish from afterwards turning slimy. The fish is not reckoned to be properly dry until it keeps itself dry underneath the dorsal fins, or is capable of withstanding the pressure of the thumb without leaving marks in the thick of the flesh. After the fish has been put in pressing piles and has been spread out for drying four to five times, it will, under fair circumstances, be reckoned to be properly cured. The usual time, under favorable conditions, taken to cure fish in Norway is about six weeks.

FRENCH METHOD.

The fish which is brought to France is for the greater part bank fish, caught on the banks of Newfoundland and on the coast of Ireland. With the exception of the fish cured in St. Pierre and Miquelon, all this fish is cured in France, and the greater part of it in Bordeaux. To this port it is brought salted in bulk, in compartments in the vessel's hold, and cured as the orders arrive for certain quantities of fish. In splitting the fish the French cut the backbone a little farther from the tail than most nations do, and for this reason an iron spoon made for the purpose is used for removing the blood in the remaining part of the backbone. The fish is always washed well before it is put in

salt. They generally reckon on using 100 tons of salt (Mediterranean) to 2,000 hundredweight of fish, including the salt which is used in preserving their bait. While all other nations either use rock beaches, or different kinds of flakes to cure their fish on, the Frenchmen in Bordeaux use scaffolds, on which the fish is hung by the tail. This is held to be the most practical in France, because in this way the fish is cured exceedingly quick (from two to six days) with a minimum of labor expenses, and gives a real good article, although, as before mentioned, not so durable. These scaffolds are made in the following way: A number of sticks are driven down perpendicular in the ground about 1½ yards apart in a straight line from west to east, across which are fastened a row of two laths, far enough apart to admit the tail of the fish to be pushed through. About seven-eighths of a yard above this first row of laths another row is fixed in the same manner. These laths are from three-eighths to five-eighths of an inch thick and from 1½ to 2 inches wide. The arrangements of these scaffolds vary a little; some are fixed in square compartments with laths fastened alternately on the north and south sides of the posts, and with a gangway about 2 feet wide between each row of compartments. On others, again, the laths are all fastened on the north side of the posts and each row of scaffolds about 3 yards apart, in order to prevent the shade from the row in front reaching the one behind. Small cleats of wood are fastened across each pair of laths, for the purpose of keeping them together. The tail of the fish is pushed in between the laths from the north side, with the back of the fish turned upward; by its own weight it will bend down, and the face of the fish show toward the sun, while the tail is jammed between the laths. When the fish is getting a little dry it will hang this way even in a strong breeze of wind. Some have a roof covered with straw over their scaffolds when the sun gets rather hot; others again use no covering, but when the sun threatens to burn their fish they only twist it a little, so that the edge of the fish shows toward the sun instead of the face. In heavy rain, or when the sun is too hot, the fish have to be taken down and put in the stores. In France no pressing of the fish is used; as a rule it is taken down from the scaffolds and shipped to markets after being hung there from two to six days.

SCOTCH METHOD.

In Scotland nearly all of the fish is pickled, very little of it is kench-cured fish. As soon as the fish is caught and unhooked it is bled and gutted. Some of the fishermen bring with them boxes in which to keep the fish; but if boxes are not used the fish is covered up in order to prevent the sun and air from affecting it. When brought to the shore it is headed and cleansed with brushes in fresh water, and split. The backbone is cut slantwise, 20 to 22 joints from the tail, so that the cut extends over two joints, in order to give the fish a better look and strengthen it. A cut is made along the bone which is left, thus allowing the blood that remains in the veins about that part of the fish to escape or be extracted. When split, the fish is again washed in sea water and the black membrane removed. After the fish is cleansed it is pickle salted in tight-covered vessels. To 100 pounds of dry-cured fish is used 45 to 50 pounds of Liverpool salt. If less salt is used the fish is left in the pickle a couple of days more.

In regard to the amount of salt used, the board of fisheries remark that many of the curers salt their fish very heavily in order to increase the weight; but this is a great mistake, because not only is the juice of the fish extracted thereby and the weight reduced, but also, as the drying advances, incrustation of salt forms on the face of the fish, or, in other words, the fish gets salt-burned, and this debases the value of the fish very much. Lately, however, this wrong method of salting fish too heavily is abandoned in Scotland, because the curers find it to be in their own interest not to use too much. The fish is as a rule left in the salt for three days. The salting of the fish is a difficult work when the climate is damp. If the fish under such circumstances gets too little salt it will soon become dun. Whether the fish has taken sufficient salt or not, and whether it has got the required stiffness before being taken from the brine, the curer must be able to judge himself. Quite fresh fish never take more than just the proper amount of salt they claim, no matter how much salt is put on it; whereas old fish very soon get salt-burnt, if too much salt is used.

When the fish has taken a sufficient quantity of salt it is taken up and washed out again in sea water and placed in piles that slope a little for a day or two, in order to give the water a chance to run off before the drying commences. The fish, as a rule, is dried on flakes 3 feet high and 4 feet wide, the top of which is formed of wooden laths 6 inches apart, something like the American flakes. On these flakes the fish is put out the first time with the back or skin side turned down. Toward evening it is turned over, skin side up, and before sunset it is gathered in small heaps, always bearing

in mind to leave the back side of the fish turned up. The fish is turned more frequently as the drying advances. The heaps are also made larger every time the fish is spread, and weights are put on top of each heap in order to give the fish a little pressing and a smooth face. The heaps are always covered with mats or canvas. The Scottish curers are also of the opinion that the fish gets frangible or brittle and presents a bad appearance if it is dried too rapidly in the beginning of the cure. When the fish is half-dry, one is able to tell whether it is salt-burnt or not. If the fish is salt-burnt they turn it back up in the middle of the day when the sun has the most power, by means of which the salt gets extracted from the face of the fish. Mr. Ross, inspector of fisheries, recommends always to dry the fish with the skin side turned up from the time it is half dry. After it has been dried a fortnight it is put in large piles for ten days in order to allow the fish to sweat. The piles are covered well. After being taken from these piles it is spread out to dry for one week, after which it is again put in large piles for another four to six days. When after this it gets two or three days' drying it is considered to be properly cured and ready for shipment. The average time for making fish is reckoned to be from six to eight weeks.

ICELAND METHOD.

The cod fishery in Iceland is conducted by the natives in small open boats in the bays, and in some places a short distance from the shore. The gear employed by them consists of hand-line and bultows. As soon as the fish is caught it is bled; brought inshore, it is split in this way, that the remainder of the backbone is left on the opposite side to what is usual in Newfoundland and many other countries. The Icelanders split their fish very deep. After being split, the fish is washed with brushes in clean sea water, the black membrane and all blood being carefully removed. A few also used to wash their fish in fresh water. The backbone is cut slantwise, over two joints, and 18 to 22 joints from the tail, according to the size of the fish. The salting of the fish takes place in sheds as soon as the water has run off it, and it is salted in kenches with one barrel of Liverpool salt to about 350 pounds of large dry fish; if the fish is small less salt is used. After the fish has remained two or three days in this salt it is resalted in new kenches; very little salt (about one-eighth of a barrel of salt to 350 pounds of fish) is used. In this salt it remains for five or six days, and is then ready to be washed out and made, if the weather and the season of the year are suitable. The fish that is caught so late in the fall that it can not be made before the next year, is salted in kenches so heavily that one fish does not touch the other. This fish, they claim, will then, in the spring, be of about the same quality as if it was caught the same year, provided it is washed or cleaned properly and all blood carefully removed.

After the fish has remained a sufficient time in salt it is washed out and laid in small heaps, until the water has run off and a little stiffness is felt in the fish, which generally is so the next day, and if the weather then is fair the fish is spread out to dry; if not, it is relaid in square piles, from 100 to 150 fish in each. If the weather should continue to be wet the fish is piled over in new piles every day, as long as the bad weather lasts, or until it can be spread. When the fish has been spread and got two good days' sun, it is put in pressing piles and the pressing is increased according as the making of the fish proceeds. When the cure is so far advanced that the fish is what they call three-parts dry, it is put in large piles, about 7,000 pounds of fish in each. These piles are covered with mats or boards in shape of a roof, and a weight of stones, which corresponds with the weight of the fish in the pile, is placed on top of the mats or boards. In this state the fish is allowed to remain five to six days, after which time it is spread again, if the weather permits, and the same weight applied every time it is gathered and put back into the piles. In case the weather does not allow the fish to be spread, after it has been put in the first large pressing pile, it is repiled every day and the same weight applied to each pile every time until it is considered cured.

The fish is cured on beaches, which in most places are made of round rocks. The reasons why the Icelanders use such a heavy pressing in their cure of fish are: (1) That the climate is damp and not very warm (as a rule the sun is seldom hot enough to burn the fish, although this may happen occasionally) and that the weather is mostly cloudy or foggy; (2) that their fish is heavily salted; (3) that their fish is rich and thick, and stands a good deal of pressing. On account of the climate being chilly and damp, the pressing is therefore the principal part in their cure, and by frequently pressing and repiling the fish the cure is also accelerated. The Iceland fish is a fine, white-looking, good-eating and durable article which commands good prices in the markets of the Mediterranean. Although it always is a little pliable, or not cured as hard as the Newfoundland and Norway fish, still

it keeps well in hot climates, and is preferred to the hard-cured fish, because it is not so apt to get brittle and break. Fish cured in the early spring or in the fall of the year when the climate is chilly, are, if sufficiently pressed and salted, superior to the hard-cured fish in summer time, even if it is a little pliable, and will keep well in hot climates. Complaints of the hard-cured fish being brittle and difficult to handle are often made in the Mediterranean markets.

When the fish is stored in Iceland it is kept well covered with mats or canvas in order to prevent the moist air from affecting the fish. The principal market for Iceland fish is the southern part of Spain, while a part is also exported to Copenhagen and Great Britain.

STOCKFISH.

In preparing stockfish in Norway each fish is bled as soon as taken from the water, care being taken that it be not bruised or mutilated. In dressing, the fish is split from the pectoral fin to the vent, thus leaving the sides connected about the napes and near the tail. The head and entrails are removed, after which each fish is well cleansed outside and inside with sea water. They are next tied together by the tails in pairs and suspended from thick strips about 2 feet apart, on top of stands about 8 feet high. The fish are hung on each side of the strips, care being taken that they are not so close as to prevent the air currents from acting upon them. A two-pronged stick is generally used in hanging them up and taking them down. The grounds about the flakes should be clean, airy, and devoid of all putrefying refuse. During summer the fish are generally split quite through, leaving only enough meat and skin at the tail to support its own weight. The backbone is cut out from about three joints below the vent, and the fish hung up individually by the tail in such a way that one half of the fish hangs on each side of the pole. Large fish, over 28 inches in length, are also split during the winter and spring. By far the greater portion of the stockfish, however, are cured round.

The fish receive no further attention, being left out in all sorts of weather, and are not taken down from the time they are hung up until perfectly dry; that is, hard enough to withstand the strongest pressure of the tip of the thumb in the thick of the flesh along the back without giving away. In taking the fish down from the flakes, dry and fair weather should be selected in order not to leave any moisture about the fish when it is stored. In preparing for export, the stockfish is usually pressed and tied by wire into rectangular bundles, 20 by 24 by 29 inches, containing 100 kilograms or about 220 pounds. Bundles of 50 kilograms are also prepared. Norway is the only country in which stockfish is extensively prepared, about 400,000 quintals being cured annually, the species used being cod principally, but also cusk, pollock, haddock, and ling in smaller quantities. The chief markets are in Italy, Spain, Germany, Holland, and the tropical sections of the continents of America.

The Russians prepare stockfish in a somewhat different manner from that of the Norwegians. The fish is split through the back and left solid in the abdomen. A cut about an inch long is made through the uppermost part of the fish, and through this the fish is tied up on the flakes. They also prepare them in a manner similar to the Norwegian split fish, except that they do not usually take out the backbone.

Before cooking, the stockfish should be softened or disintegrated by beating with a wooden club and all bones removed. The flesh is then soaked for several hours, washed and drained. In Italy thin fish are preferred to thick ones and the disintegrated flesh is placed in cold water over a fire and removed before the water reaches the boiling point, since boiling makes it tough. Steaming is even a better method of cooking, making the flesh white and soft.

DRIED AND DRY-SALTED SALMON.

On the Alaskan coast the Indians dry many salmon for their home use during the winter, and also at times prepare cod and other fish, the work being performed mostly by the women. As soon as the salmon is caught the backbone is broken just back of the head, so as to kill the fish at once and prevent its thrashing about and bruising the flesh. The fish is dressed by slivering the two sides from the head and backbone, but leaving them connected at the tail, the knife being inserted just below the nape bone and drawn closely along the backbone to within 2 or 3 inches of the tail, when a similar cut is made on the other side and a stroke of the knife severs the backbone close to the tail. Frequently the large fish are marked by a number of transverse cuts in the thick portion of the flesh to facilitate the drying. The fish are then suspended from a pole or frame a few feet from the ground with the flesh outward, where they remain until quite dry. Sometimes when poles are not conveniently obtainable the two sides of the fish are separated and laid face up on the beach.

The process of drying requires from ten days to two weeks in ordinary weather. During rainy or cloudy weather the fish are placed under cover or turned with the skin outward. After being thoroughly dried these fish are stored under cover out of reach of dogs and children and form the principal food supplies of the natives during the winter, especially in the villages somewhat isolated from the trading stations.

Salmon when salted are commonly held in pickle in tight barrels, but a few are dry-salted for especially choice trade, in the following manner: The fresh fish is placed in a cool place until the flesh is firmly set, when it is eviscerated and split down the back, so as to lay out flat, and the head and three-fourths of the backbone are removed. If desired, the flesh may then be smeared with blood of the fish to impart a reddish color in the cured product; otherwise it is wiped clean and placed skin down in a salting tub having a layer of salt in the bottom and a layer of No. 2 salt spread evenly over the fish. Other fish similarly salted may be placed in the salting tub, but not so many as to compress the bottom layers too much. The flavor is improved by adding sugar or saltpeter to the salt, about an ounce of either for each fish, and crushed peppers may also be added if desired. The fish remain in the salt from 1½ to 3 days, when they are removed, trussed in the manner so usual in smoking (see page 494), in order to keep them out flat, and suspended in a shady but windy place until dry. The fish should be kept in a cool, dry place until used, which need not be for 2 or 3 months, according to the extent of the salting and the adaptability of the place where it is stored. Some persons pour a glass of cognac over the dry fish and allow it to soak in to improve the flavor, but this is a matter of taste. The preparation of salmon in the above manner is of very small extent, and none of the product goes upon the general market.

The first volume of the Transactions of the Highland Society of Scotland describes the method of drying salmon in vogue in Scotland a century ago as follows:

> Kippered salmon are prepared by cutting them smoothly along the back from the tail to the head. The chine, or backbone, is then cut out and all the blood and garbage cleared away. The fishes are then salted and laid above each other, with the fleshy sides in contact, in a trough, commonly scooped out of a solid piece of beech, placed in a cool situation. A lid which exactly fits the aperture is placed above them and pressed down by heavy weights. After the fishes have imbibed a sufficient quantity of the pickle they are stretched upon small spars of wood and hung up to dry where there is a current of air. Sometimes they are hung in the smoke of a kitchen fire, which preserves, indeed, but conveys a bad flavor. Some, in order to communicate a particular flavor, mix spices with the salt, or they rub the fish with spices before they are hung up to dry.

DRY-SALTED MULLET.

In the extensive mullet fisheries of the southern coast from North Carolina to Florida large quantities of this species are dry-salted or kench-cured, the annual output on the coast of Florida amounting to nearly 2,000,000 pounds. Some are pickled in brine, but the majority on the west coast of Florida are dry-salted. The process employed is as follows:

Dressing begins as soon as the fish are landed at the station, which is generally within a few minutes after they are removed from the water. In splitting, each fish is taken in the left hand with the tail toward the splitter, and by means of a knife it is opened along the left side of the backbone from the head to the tail, in much the same way that mackerel are split. All viscera are then removed and a gash or "score" is cut along the right side of the fish, which contains the backbone, in order that the salt may the more readily penetrate the flesh. In some localities the heads of mullet are removed before the fish are split. When roe-mullet are taken the roe bags are carefully removed while the fish are being eviscerated and are salted separately. The blood and black stomach membrane adhering to the napes are then scraped away and the fish are thrown into a trough of clean salt water, where they remain for a few minutes and are thoroughly washed, all particles of blood being carefully removed. On removal from the washing tank or barrel the fish are rubbed thoroughly with salt, Liverpool salt being most commonly used. They are next piled up under cover in kenches, with a sprinkling of salt between each layer, with the backs placed downward, as is the case with green cod, so as to retain the dissolved salt. These kenches are ranged in regular order, with the heads of the fish outward, and extend 3 or 4 feet in height. In some localities, after the salting and before kenching, the two sides of the fish are brought together again, leaving the fish in natural shape, with the abdominal cavities filled with salt.

When a large haul of mullet has been made the work of dressing and salting must be rushed to prevent the fish from becoming tainted; and in warm weather, especially during August, if the fish are not salted within a few hours after landing they are apt to become discolored or to rust. The fish remain in these kenches until they are to be placed on the market, which may not be for three or four months.

In preparing for shipment the salted mullet are placed in boxes or tied up in bundles. No uniform style or size of package is used, resulting naturally in much confusion and inconvenience to the trade. Some fishermen simply bundle the mullet in such a way that the skin side is outward, while others cover the bundles with a single layer of matting or palmetto leaves. When carefully prepared these fish are of excellent quality, except that those cured during the warm weather of July and August sometimes rust.

The following method of curing mullet is recommended to those who wish a really choice product without regard to the cost of preparation:

> The fresh fish are cut along the ventral part and eviscerated. They are next soaked for two hours or so in salt water, beheaded and split down the back, and the backbone removed. Four or five cuts are then made transversely across each half of the fish on the inner surface, and the fish are packed in dry salt, where they remain for about one week. On removal they are washed to remove the slime, undissolved salt, etc., and then suspended in the shade, where they are allowed to dry for five or six weeks. Each fish is then sprinkled with fine table salt and carefully wrapped with waxed or paraffin paper to exclude the air, and suspended in a well-ventilated room, where it may be kept for several months under favorable conditions.

DRY-SALTED CHANNEL BASS.

Channel bass or drumfish are caught in considerable numbers along the south Atlantic coast during the late summer, and the small demand for them in the fresh-fish trade results in many of them being salted for local use during the winter, especially along the North Carolina Banks. The following process is employed:

Each fish is split down the belly and eviscerated, the head is cut off with a hatchet or large knife, the backbone is removed, and the fish split in halves. Each half or fletch is then scored lengthwise from the napes to the tail on the flesh side, the cuts being about 2 inches from each other and penetrating the flesh to the skin. The fletches are washed free from blood, etc., and placed in barrels or vats with dry salt sprinkled in abundance among them and with strong brine poured over them. When sufficiently cured the fish are removed from the pickle and placed in the open air on boards, benches, or any convenient place for drying. Care must be taken to shield them from rains, and they should be placed under cover at night to protect them from heavy dews. When sufficiently dried they are stored in a cool, dry place until marketed.

The reduction in weight through dressing amounts to about 50 per cent, and through curing and drying about 33 per cent additional, making the dried weight about 35 per cent of the round weight. The only market is among the coast people—among the fishermen and their neighbors on the mainland. They sell for 8 to 15 cents per side, or 15 to 30 cents per fish, an equivalent of 1 to 2 cents per pound.

DRY-SALTED KINGFISH.

The great bulk of the kingfish caught in this country is sold in a fresh state; but at Key West and some other points on the coast when the fresh-fish market is fully supplied, the surplus catch is salted. The method usually employed at Key West in drying and salting the fish is thus described by Mr. W. H. Abbott:

If the fish are not disposed of the first day after being caught, they are lightly salted and dried in the sun, in which condition they will keep for a week or two, and if the weather is favorable they will probably keep a week longer, and if quite thoroughly dried the fish will keep a much longer period. Generally the fisherman is a man of very little means and has no capital to work with; consequently the supply of salt which he is able to buy is very small. The salt used is from the Bahama Islands. The fish are laid on a box or bench and the thick part of the fish cut transversely, nearly through to the skin, at distances of 1 to 1½ inches apart. After the fish have been prepared in this way, the fisherman takes a small amount of salt and carefully sprinkles it over the entire surface of the fish and into the cuts, so as to make sure of their being properly cured. He is very careful not to waste the salt by scattering it about otherwise than on the fish. If the fish are to be sold in a few days, they are not exposed to the sun; but if to be kept for a longer period it is necessary to have some of the moisture taken out by the direct rays of the sun.

In a report on the Gulf fishing-grounds and fisheries, by J. W. Collins, the following description occurs:

As a rule, the great bulk of the kingfish taken by the Key West fleet is sold and eaten in a fresh condition, but occasionally some fish are salted on the boats, and a greater quantity are split and salted after they are landed, the surplus being disposed of in this manner. These salted fish are often dried, and to facilitate this and to insure the more thorough drying of the fiber the thick part of the flesh is cut transversely nearly to the skin, at a distance of about an inch apart. There is no systematic method of drying, as in curing cod, but the fish are hung across rails, spread on wood piles, or disposed of in any other manner where they may have a chance to dry, a favorite method being to suspend them by the tail. Cured in this way they make tolerably good food, but it is altogether probable that a much finer article of food might be obtained by smoking the fish.

The amount of kingfish prepared for market in this way is not known, but it is relatively small.

DRY-SALTED BARRACUDA AND BONITO.

On the southern coast of California, in the vicinity of San Diego, from 150,000 to 300,000 pounds of barracuda (*Sphyræna argentea*), about half that quantity of bonito (*Sarda chilensis*), and some yellow-tail or amber-fish (*Seriola dorsalis*) are annually dry-salted and sold in the markets at 3 or 4 cents per pound. As soon as practicable after they are removed from the water, they are split down the belly and dressed like cod, only the backbone is not usually removed, and heavily salted in kenches similar to those on the New England coast. When the weather is favorable the fish are washed and spread on drying flakes, the cure being completed in two or three days in case of barracuda, while a greater length of time is usually required for bonito. 100 pounds of round fish make about 50 pounds dried. When properly cured barracuda present an inviting appearance, being white and dry, and the flavor is excellent; but most of the California product is said to be dark in color and with a strong flavor, due probably to faulty methods of curing.

CHINESE SHRIMP AND FISH DRYING.

In the Barataria region in Louisiana, along the shores of San Francisco Bay in California, and at other points on the Pacific coast, there are camps of Chinamen whose principal occupation is the drying of shrimp and fish, mainly for Oriental markets. Their output also includes miscellaneous varieties of fish, oysters, squid, etc., the aggregate annual product amounting to about $100,000 in value.

The drying of shrimp was begun in Louisiana in 1873 by Chin Kee, whose plant was located on the western bank of the Mississippi River opposite New Orleans. The following season he moved to Bayou Dupont, near the head of Grand Lake, about 80 miles below New Orleans. In 1880 a second establishment or "platform" was built near Bayou Cabanage. A third platform was built in 1885 at Bayou André. The business continued fairly prosperous until 1893, when the severe storm in October completely destroyed the Bayou André platform and camps and severely damaged the other two platforms. The latter, however, were immediately repaired, and in 1897 another platform was erected about a mile above Cabanage.

These shrimp-drying establishments consist of a large platform, on which shrimp are dried, the necessary furnaces and kettles for boiling, warehouses, living apartments, storehouses, wharfage, apparatus, etc. The platforms range in area from 25,000 to 80,000 square feet, and are substantially built of pine boards 1 inch thick with close joints. The number of employees at each establishment ranges from 6 to 12.

Prior to 1886 the shrimp were boiled in kettles over open fires, but since that date greater neatness and economy of fuel have been secured by the use of a grate with a chimney, somewhat similar to the old form of sugar-boiling. The kettles over the grates are 5 feet long, 4 feet wide, and 18 inches deep, with a division in the center.

The shrimp are received from the fishermen each day, thus insuring their freshness and rendering the use of ice unnecessary. Prior to 1888 the price paid was 80 cents per basket, containing about 84 pounds; but since that date the price has been uniformly 65 cents per basket. When measured and received from the boats, the shrimp are rinsed and placed with water and the necessary quantity of salt in the kettles, each kettle holding about 5 baskets of shrimp. About 4 or 5 pounds of salt are used for boiling 100 pounds of shrimp, Liverpool salt being preferred, but coarse American salt is also used.

The brackish lake water suffices for cooking, and it is used for several successive boilings, additional water and salt being added as necessary. The shrimp are boiled for five or ten minutes, when the cover is removed and the shrimp stirred thoroughly with a paddle or other appliance. The cover is then replaced for 10 or 15 minutes longer, when the shrimp are removed with perforated skimmers or shovels and spread on the platform, where they are exposed to the action of the sun, being turned and separated at intervals during the day and covered, when necessary to protect them from moisture, until the drying is completed, this usually requiring two or three days. When shrimp are coming in plentifully the boiling is frequently kept up all night, the boiled shrimp being placed in heaps on the platform and covered with canvas until morning. When thoroughly dry, the Chinamen, with clean shoes or moccasins, tread them for a time to detach the shells and heads from the main part of the flesh. These shells and light particles are fanned off by throwing the shrimp upward through the air, somewhat in the same style as that practiced with wheat, rice, and other similar grains. The meats of the shrimp are then placed in sacks, beaten and thoroughly shaken to complete the breaking up and removal of the shells, after which they are again winnowed or passed through hand sifters, so as to remove all dust and particles of shells adhering to them. They are next made ready for shipment by placing them in flour barrels, containing about 200 pounds each, and are sent to the various markets. In packing, the shrimp should be graded, the whole bright meats being kept separate from those broken or discolored on account of rains during the process of curing.

Each basket of green shrimp yields about 9½ pounds of dried shrimp, which sells for about 14 cents per pound. The market is among Asiatic races almost exclusively. The great bulk is sent to San Francisco, but some are shipped to New York, Philadelphia, Chicago, and Havana. From San Francisco the shrimp are sent to China, Japan, and throughout the west coast of the United States. The quantity dried during the past four or five years in Louisiana has been much less than previous to 1893, and the profits have greatly decreased, owing to competition with Mexican ports.

The following summary shows the quantity prepared in Louisiana during each year since 1886:

Year.	Dried shrimp.	Year.	Dried shrimp.
	Pounds.		*Pounds.*
1887	304,200	1893	121,800
1888	319,000	1894	83,200
1889	346,400	1895	116,000
1890	293,600	1896	144,400
1891	280,200	1897	151,400
1892	285,200		

The method of drying shrimp practiced by the Chinese at San Francisco is thus described by Mr. Richard Rathbun:

After the day's fishing is over it is usually customary to carry the fresh shrimp to the Vallejo street market in San Francisco in live-baskets covered with a netting, which has a hole in the center closed by means of a puckering string. At the market the live shrimp sell at the rate of about 10 cents per pound, and those remaining unsold are carried back to the Chinese settlement and put at once into boiling brine. The kettle for boiling the shrimp is a rectangular iron tank 6 feet long by 4 feet wide and 2 feet deep, with a fireplace underneath. After sufficient boiling, care being taken to prevent overcooking, the shrimp are taken out and spread to dry upon level plats of hard ground, which have been previously stripped of grass and rendered perfectly smooth. They are spread out and turned occasionally by means of a hoe-like broom. After four or five days, or when perfectly dry, they are crushed under

large wooden pedestals, or trod upon by the Chinese in wooden shoes, for the purpose of loosening the meats from the outer chitinous covering, after which the entire mixture is put through a fanning mill for the actual separation of the meats and shells. The fanning mill, a somewhat crude affair, is constructed of wood by the Chinese on precisely the same principle as the one used for winnowing grain. It measures about 8 feet long by 5 feet high, and consists of a square box, divided on the inside for the passage of the separated shells and meats, with a hopper above, and a large fan wheel worked by a crank at one end. The meats are partly used at home or at the various inland Chinese settlements, but are mostly shipped to China. The shells are also utilized as manure to some extent about San Francisco; but, like the meats, are mostly sent to China, where they serve as a fertilizer for rice, tea plant, etc. In San Francisco they sell at about 25 cents per hundredweight. Both the meats and shells are shipped to China in sacks. The trade is entirely in the hands of Chinese merchants, who ship by way of Hongkong. The meats are eaten by all classes in China, but are cheaper and less esteemed than the native shrimp, which are comparatively scarce.

Dried shrimp form a very popular article of food among Asiatic races and are worthy of more extended use in this country. They are very nice rolled in butter and fried, good for making curry, and for "jumbalayer" they are excellent. In China many of the broken shrimp are made into paste by grinding between stones.

In 1885, in connection with their shrimp drying, the Chinese on the Louisiana coast dried a quantity of oysters for market, but the venture was unsuccessful on account of the high price at which it was necessary to sell the product in order to reimburse them for their outlay, 50 cents per pound for the dried oysters being scarcely sufficient to meet expenses.

The tails of the rock lobsters or salt-water crayfish (*Panulirus interruptus*) are frequently dried in the sun without previous boiling or salting by the Chinese on the Pacific coast, but the aggregate of the business is not large.

Since 1885 the Chinese located at Barataria Bay, Louisiana, have dried a quantity of fish each summer. In doing this they make temporary quarters on Timbalier Island, in Terrebonne Parish, Louisiana, using old material from the permanent camps in Jefferson Parish. Tarpaulin or palmetto supplies sheltering for the workmen, and small slat-work frames, about 8 feet long by 4 feet wide, are used for holding the fish, which are turned every few hours by placing a second frame on the one holding the fish, turning both together and then removing the first frame. The season extends usually from May 1 to June 30, and from one to three weeks is necessary for the drying.

All varieties of salt-water fish are there dried except the small bony ones and those excessively fat. Few of the fish are dressed before drying, the head, scales, fins, and viscera remaining, except that the large redfish or channel bass are eviscerated and have the heads and fins removed. The fish are purchased from the seiners at a cost of $1.40 per basket, containing about 98 pounds. A basket of green fish yields about 47 pounds of dried, which sells for 4 or 5 cents per pound wholesale. In 1897 the two companies operating on Timbalier Island received about 1,300 baskets of fish, which yielded 61,100 pounds of dried fish, valued at $2,936.

On the Pacific coast the Chinese usually remove the heads and viscera from the large fish, and in some localities they salt the fish in brine and then dry them, much like the present method of curing cod. Some of the larger sharks and skates are split through the back and hung on poles. The barracuda, albacore, and bonito are split lengthwise along the back, soaked for 2 days in brine, and then dried in the sun, losing about 50 per cent of their weight in drying. The flesh of the dried barracuda resembles codfish somewhat, being white and firm. They usually sell in San Francisco at 3 or 4 cents per pound wholesale.

DRYING SALMON AT UNALASKA, ALASKA.

CHINESE SHRIMP-DRYING ON SHORE OF SAN FRANCISCO BAY, CALIFORNIA, SHOWING SHRIMP, NETS, ETC.

The redfish (*Trochocopus pulcher*) are dressed by opening the abdomen and removing the viscera, and Chinamen exhibit much ingenuity in giving a picturesque appearance to the head and teeth of this species. According to Dr. D. S. Jordan:

A "junk" with the deck covered with drying redfish seems at a little distance to be full of frogs about to leap. Sometimes I have noticed that the fatty protuberance on the forehead of the redfish has been cut off. This is valued as a delicacy and used for fish chowder.

Squid are dried in small quantities by Chinamen on the coast of California. They are washed and spread out on small slat-work platforms or flakes. The large squid are first split, but the small ones are dried in the condition in which removed from the water. The largest squid-drying establishment is located at Point Alones. There some of the flakes are placed on the ground, but the majority are elevated on posts 2 or 3 feet high, and resemble somewhat the codfish flakes of New England, the principal difference being that the squid flakes have the slats much closer together than those used for codfish. About 10 days are required for the process of curing, and no salt whatever is used. When thoroughly cured they are packed in bundles, each containing about 135 pounds and upward, and each package is covered with matting. They are sent to San Francisco, where some are sold to the domestic trade, and the remainder exported to the Hawaiian Islands and to China.

DRIED STURGEON PRODUCTS.

In the sturgeon fisheries of Russia and of Asiatic countries, and quite recently, to a small extent, in the Columbia River fisheries the spinal cords of the sturgeon have been utilized. After being cleaned and dried this substance is excellent for fish pies, soups, chowders, etc. The method of its preparation in Russia is as follows:

After the fish has been eviscerated an incision is made in the flesh, and by means of a hook enough of the spinal cord is drawn out to furnish a good hold for the fingers, by means of which the whole is extracted in a band, 4 or 5 feet long, consisting of a round whitish substance, marked or slightly disconnected at intervals like sausage links. It is carefully washed in fresh water to remove the blood and slime, and is then drawn by a workman between the edge of the washtub and his left hand, or similarly compressed, to remove the soft viscous matter or nerve tissues contained within; or sometimes it is cut open and those tissues scraped away and discarded. After this operation the substance is rinsed in another tub of fresh water until it becomes quite clear, and it is then exposed in a free circulation of air until it is thoroughly desiccated. For marketing, it is cut into pieces 4 or 5 inches in length, or it is tied in bundles composed of a number of spinal cords. On the Columbia River it sells for about 40 cents per pound, and in Russia it sells for the equivalent of 40 to 60 cents per pound, 25 of the common sturgeon of Russia (*Acipenser guldenstädtii*) being required to furnish 1 pound of véziga or viaziga, as the product is commonly known in the European markets.*

The preparation of the spinal cords of sturgeon on the Columbia River is thus described by Mr. W. A. Wilcox:†

One product of the sturgeon is used entirely by the Chinese, namely, the spinal marrow. As soon as the fish are landed at the packing establishment a Chinaman, armed with a hook, pulls out enough of the marrow to furnish a good hold; then, seizing it, draws the remainder of it out, hand over hand. In the average-sized sturgeon the spinal cord is 4 or 5 feet long and consists of long, white connecting links resembling sausages. These are cut open and the jelly-like substance contained within is scraped off and thrown away. This marrow is known by the Chinese and the trade under the name of "bone." It is thoroughly dried, and if not sold to the Chinese in this country it is exported to China, where it is much prized for making soups. The Chinamen pay 4 cents a pound for this "bone" and remove it from the fish themselves.

* See Rapport sur les Expositions Internationales de Pêche, par J. L. Soubeiran, Paris, p. 151.
† Report U. S. Commission of Fish and Fisheries for 1893, p. 252.

The following description of the methods of drying sturgeon meat—or, more properly, the dorsal portion of the fish—in Russia is extracted from Alexandre Schultz's, "Notice sur les pêcheries et la chasse aux phoques dans la Mer Blanche, l'Océan Glacial et la Mer Caspienne," St. Pétersbourg, 1873:

For making good "balyk" a large and tolerably fat fish is selected, whose head, tail, sides, and belly are taken off. That which remains, the dorsal part, has to undergo a special salting, while the other parts are salted in the usual manner. The backs of the common sturgeon (*Acipenser guldenstädtii*) and of the "sévriouga" (*Acipenser stellatus*) remain entire, while those of the large sturgeon (*Acipenser huso*) are cut, either lengthwise only or else both lengthwise and crosswise. The pieces are placed in a tub so as not to touch each other nor the sides of the tub; and they are left thus after having been covered with a thick layer of salt from 9 to 12 days, and even 15 days when the pieces are large and the weather is hot. The salt is mixed with a little saltpeter, to give to the balyk a reddish color, 2 pounds of saltpeter to 50 poods [1,800 pounds] of balyk. Allspice, cloves, and bay leaves are frequently put into the brine. When the salting is finished, the balyk is put into water for a day or two, in order to detach all particles of the brine from it. Thereupon it is dried, first in the sun and then in the shade, on roofed scaffoldings, which are erected for the purpose. This last-mentioned operation requires from 4 to 6 weeks, and is considered finished when the balyk begins to cover with a slight mold, the absence of which shows that it has been salted too much.

Good balyk must be as soft and tender as smoked salmon; must have a reddish or orange-brown color; and must have an odor something like that of the cucumber; it must also be transparent, show no traces of putrefaction, nor have a bitter taste; and, finally, it must not be too salty. There are very few manufacturers who can prepare balyk that has all these qualities.

A pood (36 pounds) of good balyk costs at the manufactory at least 18 rubles ($12.60), and at retail it can seldom be bought for less than 1 ruble (70 cents gold) a pound. The balyk made in March is considered the best. On the banks of the Koura, and in the traus-Caucasian waters, where the sévriouga (*Acipenser stellatus*) is caught in large numbers, balyk is made of at least 300,000 of these fish every year. This balyk, commonly called "djirim," is not of the first quality. It is dry, very salty, and is much sought after by the inhabitants of Kachetia, because it produces thirst and gives them occasion to quench it with the excellent production of their vineyards. A large sturgeon of 20 poods (720 pounds) yields 5 poods (180 pounds) of balyk; a very large sévriouga, 15 pounds; a common-sized sévriouga, 4 pounds; and the common sturgeon, from 8 to 12 pounds.

DRIED TREPANGS.

The preparation for market of the soft echinoderm variously designated as sea-cucumber, sea-slug, bèche de mer, trepang, etc., was once attempted on the Florida coast. The trepang is a very popular food product in oriental countries, esteemed not only by the natives, but by foreigners residing in those countries. China imports annually about 5,000,000 pounds, at an average valuation of 20 cents per pound, from the South Pacific Islands and Japan, where the holothurian is very abundant. In preparing trepangs for market, they are boiled in water for from 10 to 30 minutes, according to varieties and sizes, split down on the side, eviscerated, and then exposed to the sun until perfectly cured. In some countries, as in Malay Islands, they are dried over a wood fire, but this product is less desirable than if dried in the sun. It is important that they be kept dry until they reach the consumers, otherwise they become flaccid and decay.

Mr. Silas Stearns described the fishery attempted on the Florida coast as follows:

In 1871 an Englishman came to Key West, Fla., for the purpose of gathering and preparing trepang for the Chinese market. He erected a shed, under which were built fireplaces, with large kettles and other arrangements, and also frames for drying. He arranged with the fishermen, and fishermen's boys particularly, to bring him all the sea-slugs they could obtain, for which he was to pay a certain price. As the slugs were very abundant on the shoals about Key West, and the prices paid for them

were liberal, no trouble was experienced in obtaining large supplies. The sea-slugs, still alive and fresh, were thrown into the kettles and boiled a certain length of time, but as to the composition of the liquid in which they were cooked, my informant could not tell me. Then they were taken out, the outer rough skin rubbed off, and the body split with a knife, after which the intestines were removed and the body spread on canvas in the sun to dry. The next operation after drying, and the final one, was to smoke them. This was done in a smokehouse of the ordinary kind, in which they were suspended on slats. After the final process the trepang were packed in bales, covered with sacking, and shipped to New York, where they were probably reshipped to China. For two seasons (winters) this industry was kept up, and apparently with much success; but at the close of the second season the houses and apparatus were sold, and the operator left Key West. Since then nothing further has been attempted in the trepang industry there.*

Trepangs are abundant on several other portions of the United States coast, and especially so on the northwest coast and among the Alexander Islands, and there seems no reason why these supplies should not be utilized and an industry of considerable importance developed.

The following description of the method of curing trepangs among the East Indies is from The Commercial Products of the Sea, by P. L. Simmonds:

The first thing to be done on arrival at an island where the slug is plentiful is to erect on shore a large curing-house about 90 feet in length, 30 feet in breadth, and about 10 feet high. These houses are generally built of island materials and thatched with mats of cocoanut leaves; this thatch must be well put on, so as to prevent the rain from penetrating. The sides are likewise covered with these mats, and a small door should be left in each end. Platforms for drying the slugs are then erected along one side of the house. They should run the whole length and be about 8 feet in breadth, the lower one about breast-high from the ground, and the upper 3 feet above that. The frames are generally made of cocoanut trees and covered with two or three layers of split bamboo or reeds, sized close so as to form a sort of network for the slugs to lie on. Much care and skill is required in the construction of these platforms, so as to prevent the bèche de mer from burning. A trench about 6 feet in breadth and 2 feet in depth is then dug the whole length of the platforms for the fires. Tubs filled with salt water are placed at short distances along the side of the trench and a supply of buckets kept in readiness to prevent the fires from blazing up and burning the fish or platforms, as well as to regulate the degree of heat necessary for drying the slugs.

The process of curing is this: The bèche de mer is first gutted, then boiled in large pots, and, after being well washed in fresh water, carried into the curing-house in small tubs or baskets and emptied on the lower platform, where it is spread out (about 5 inches thick) to dry. The trench is then filled with firewood, and when the platform is full of trepang the fires are lighted and the drying process commences. From this time the fires must be kept constantly going day and night, with a regular watch to attend to them. On the afternoon of the following day the fires are extinguished for a short time and the slugs shifted to the upper platform, having been first examined, and splints of wood put into those which may not be drying properly. When this is done, the lower platform is again filled from the pots, the fires immediately lighted, and the drying process continued as before. The slugs on the lower platform must be turned frequently during the first 12 hours. On the second day (the fires having been extinguished as before) the slugs on the upper platform are shifted close over to one end to make room for those on the lower platform again, and so on as before for the two following days, by which time the first day's produce will be properly cured. It is then taken off the platform, and, after having been carefully examined, and those not dry put up again, the quantity cured is sent on board the vessel and stowed away in bags. But should the ship be long in procuring a cargo it will require to be dried over again every three months in the sun, on platforms erected over the deck, as it soon gets damp, unless when packed in air-tight casks.

If the bèche de mer is plentiful and the natives bring it daily in large quantities, 40 men will be requisite to perform the work of a house of the above size, and the pots will want two hands to attend them. These curing-houses consume a large quantity of firewood daily. When bèche de mer is cured and stowed away great care should be taken to prevent it from getting wet, as one damp slug will speedily spoil a whole bag.

* Fishery Industries of the United States, sec. v, vol. 2, pp. 815-816.

It appears that there are two ways of boiling bèche de mer, equally good. The first is to take them out when boiled about a minute, or as soon as they shrink and feel hard; the other method is to boil them for 10 to 15 minutes; but in boiling either way the slugs ought, if properly cooked, to dry like a boiled egg immediately on being taken out of the pot. Bèche de mer dried in the sun fetches a higher price than that dried over a wood fire. But this method would not answer in curing a ship's cargo, as they take fully 20 days to dry, whereas by smoking them they are well cured in 4 days. Much skill is required in drying bèche de mer, as well as in boiling it, as too much heat will cause it to blister and get porous like sponge, whereas too little heat again will make it spoil and get putrid within 24 hours after being boiled. There is, likewise, great care and method requisite in conducting the gutting, for if this be not properly attended to by keeping the fish in warm water and from exposure to the sun it will, when raw, soon subside into a blubbery mass and become putrid in a few hours after being caught.

DRYING FISH BY ARTIFICIAL MEANS.

A number of devices have been invented for drying fish by artificial means, by the use of heat, dry air, absorption pads, etc., but none have come into practical use on a large scale. In 1878 there was introduced a drier,* consisting of one or more horizontally revolving wheel-like tables, having two outer rings with a bottom of network on which to place the fish and a corresponding covering of network to overlie and retain the fish during the rotation of the table. The tables are in sectional form to admit of the fish being removed from any portion without disturbing that in any other portion; the whole is supported by converging arms radiating from a vertical spindle. After the fish are placed within the network frame the structure is rotated at a speed to be regulated by circumstances, thus creating a current of air, causing a rapid drying of the fish.

A system modeled somewhat on that used in fruit-driers was introduced in 1877.† The fish are dressed and placed in a tight vessel on a false perforated bottom a few inches above the real bottom. Steam is admitted and the fish cooked until freed from the bones. The flesh is then spread on hurdles, which are introduced successively into a chamber, into the lowest part of which is admitted a current of air heated to about 200°. After the first has been exposed to this temperature about 10 minutes, it is moved up about 4 inches and a second introduced, and so on successively until there are 10 or 12 hurdles in the chamber, and thereafter as each additional hurdle is placed at the bottom the top one is removed.

During this operation the moisture evaporating from the fish forms a vapor which fills the drying chamber, thus keeping the fish in a humid atmosphere and preventing it from becoming suddenly dry and hard on its surface, and the texture is kept loose to allow the water to evaporate freely.

This process did not prove a success, and in 1880 Mr. Alden, the patentee of the above, introduced an improved method, as follows:

Take fresh fish and remove the heads, tails, fins, entrails, and skins, and also the larger bones, leaving the clear fresh fish meat, which should be cut in pieces of suitable size, thoroughly cleansed in pure cold water, and then placed in an evaporating pan placed upon and surrounded by a heating coil or a steam jacket, and having one or more movable blades revolving around on the inside of the pan, so arranged that when in motion the blades will operate upon the principle of the plow, so as to avoid shoving the mass while throwing a furrow in such manner that the fresh fish meat is prevented from adhering to the bottom or the sides of the pan, and is kept constantly in a revolving motion, so as to admit free access of the drying atmosphere for rapidly removing the vaporized moisture, in aid

* See United States Letters Patent, No. 207913.

† See Letters Patent, No. 186893.

of which a fan or vacuum chamber may be used, and the mechanism may be operated by steam or other power. When the evaporated fresh fish meat has been placed in the evaporating pan, steam is applied to the heating coils or steam jacket, and the revolving blades are immediately set in motion, the operation or effect of which is within a few minutes to dissolve the fish meat into a jelly-like mass, in which condition, when kept in motion, it soon loses all its free moisture, rapidly disintegrates, and becomes dry or solidified fresh fish fibril, having much the appearance of fine broken vermicelli. Under this method the fish fibril separates and entirely frees itself from the minute or smaller bones, so that they may readily be removed. The fresh fish fibril should be kept in rapid motion until sufficiently dry to remove from the pan (which is determined by its failure longer to throw off vapor), when it should be spread upon cooling screens or muslin until cold, when it may be packed in tin, wood, or paper boxes for keeping or for transportation. Under this process the time required is from thirty to forty minutes, and the temperature must be kept below the cooking point, so as to prevent coagulation of the fish gelatine, and the product, or fresh fish fibril, will, in proportion by weight, be as 1 pound to 10 pounds of live fish, and 5 pounds of prepared fresh fish meat. The greatest possible celerity should be had and care taken that the prepared fresh fish meat is entirely fresh, pure, and without taint. Fresh fish put up after evaporating its free moisture and being fibrilized in the manner described retains its entire nutriment and flavor, is free from all foreign and injurious substances, contains no salt, has no affinity for moisture, and will keep in any climate for a long time.

A plant was established at Gloucester, Mass., in 1881, for the preparation of Alden's specialty, but it did not compete successfully with the boneless codfish, then being prepared in such large quantities at that port.

By a process designed in 1879 by Mr. J. M. Reid,* of Canada, fish previously brine-salted are placed in a tight receiver and subjected for a time to compressed heated air for the purpose of extracting the moisture.

Another method that promised success was put in operation at Gloucester in the spring of 1883, it being the invention of Halifax parties.† Two apartments were fitted up with flakes, the floors being partly open to allow the air to circulate. By means of piston blowers, or of fans operated by steam power, the external air was drawn in from one side of the building and forced over the fish and out on the other side, when the atmosphere was in suitable condition for drying. But when it was loaded with moisture both the inlet and outlet connecting the room with the outside air were closed and communication opened with a cooling room overhead, the temperature of which was lowered by cakes of ice, and the air contained in the drying and cooling rooms was forced over the fish, thence through the cooling room, and back again over the fish and so on, continually keeping the fish cool. The inventor claimed that the fish were brighter and contained less dirt and dust than those dried on flakes, but the expense of the process was considerable and consequently it was soon abandoned.

In 1890 Mr. Cathcart Thompson, of Halifax, brought to notice a process by which he claimed that codfish can be dried by absorbent pads, thereby obviating the dangers and delays of the present method. This process was originally as follows:

A layer of green-salted fish is spread evenly on an absorbing pad. Common gunny cloth makes a good, cheap, and effective one. Another pad is laid over this, succeeded by another layer of fish, followed again by a pad, and so on successively until the whole quantity of fish is spread, a pad being placed over the last layer. A platform of boards is then laid on this, and weights or other appliances are used to cause a slight, continuous, and uniform pressure. The pile is allowed to remain from 24 to 48 hours, during which time the pads become saturated with moisture, which they have extracted from the fish. Repiling then takes place, dry pads being substituted for the wet ones, the latter being dried for further use. Repiling with the substitution of dry pads is continued till the fish have become sufficiently dry, a week or ten days being long enough to effect this object if intended for the home or West Indian market. For more distant markets a somewhat longer period would be required.

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* Letters Patent No. 221357.

† See Letters Patent No. 250382, dated December 6, 1881.

In 1892 Mr. Thompson introduced the following improvement on his method:

A number of light frames of 2 by 1½ inch lumber, 6 feet in length and 3 feet in width, are constructed. One of these is laid upon the floor and a layer of dry moss and sawdust is spread thereon. This is covered with a sheet of cotton cloth large enough to envelop the frame, a layer of fish is spread flesh down thereon, and the whole is covered by another sheet of cotton. A second frame is placed over the first one and the same process is continued till a height of 3 or 4 feet is attained, then a thick layer of moss or sawdust is placed over the last tier of fish and a cover of boards sufficiently large to go inside the frame is laid over all. Pressure is then applied, by screw or lever, to thoroughly embed the fish in the absorbent. The spreading of the moss and sawdust over the layer of fish fills up the interstices between them and brings every part in contact with the absorbent, and at the same time prevents the fish from being pressed out of shape.

In the twenty-fifth annual report of the Canadian Department of Marine and Fisheries the following account of the above-described process is given:

A quantity of 200 pounds of cleaned fish, put under Thompson's process, gave the following weights:

Duration of test.	Weight.	Percentage of loss.
	Pounds.	
After 72 hours pressure	170	15
After 120 hours pressure	155	22½
After 192 hours pressure	144	28
After 264 hours pressure	134	33
After 312 hours pressure	128	36

Thus, 200 pounds of cleaned fish, after a pressure of 312 hours, is reduced to 128 pounds, 36 per cent moisture being extracted. This seems sufficient to establish the fact that in this way enough moisture can be extracted by simple and cheap means to secure the fish against damage at times when drying under the ordinary process would be impossible. This method could be employed with great advantage by fishermen at the places of catch, as the moisture could be removed from the fish continuously and quite independent of weather. They could then be placed in piles, and the first fine day taken advantage of for final drying. For fish which have been cured by Mr. Thompson's experiment, six hours in the sun should suffice for the United States market, and from 24 to 48 hours to render them suitable for the Brazil markets, where hard and very dry fish are required. Mr. Thompson intends to continue his experiments on a larger scale, to enable him to make the final test of sales in foreign markets, when a further report will be made, and, if successful, a bulletin will be issued by this department. The different experiments were inspected by experienced fish-merchants, who have certified that in their opinion the extraction of 30 per cent will secure the fish from damage until suitable weather offers for their final drying by exposure to sun and air—for the removal of the remaining 10 per cent to 15 per cent. This they consider would not require more than from 6 to 48 hours of good drying weather, according to the market for which the fish are intended.

Mr. Thomas S. Whitman, of Annapolis, Nova Scotia, obtained letters patent on May 10, 1892, in the Dominion of Canada, and on the 13th of February, 1894, in the United States, for an improved process of curing and drying cod by exposing the fish alternately to artificial heat and to currents of fresh, cool air. The inventor claims that by his process fish can be cured much quicker than by the present system and without any of its injurious effects, and that the exact quantity of moisture desired can also be removed from the fish, so as to suit the taste of consumers in different countries.

The following description applies to Mr. Whitman's process:

The wet-salted fish are taken from the kench and washed, after which the surface water and pickle is pressed out of the fish by steam press or otherwise. After having been in press for a few hours the fish are ready to be spread on the wire flakes or trays that are placed in rows about 9

inches apart, the rows of flakes or trays being contained in compartments that are traversed by pipes in which steam or hot water is permitted to circulate. The maximum temperature which the steam or hot water in the pipes should impart to the compartments is about 95° F.

The fish having been spread upon the trays or flakes in the compartments are allowed to remain in a temperature of 90 to 95 degrees for a few hours, until they are thoroughly warmed, whereupon currents of cool, dry air are forced over and under the fish on these flakes or trays. These currents of dry air come from channels or flues that open into the compartments. By opening and closing these cold dry-air flues at proper intervals of, say, two or three hours, thus alternately cooling and heating the fish, from 1 to 2 per cent of moisture per hour is taken from the fish. The products of evaporation are carried off from the compartments by flues running to a chimney, or suitable ventilators may be placed in the tops of the compartments for carrying off the moisture to the roof of the building, or otherwise. It will be perceived that if the heating process were carried on by itself continuously instead of interruptedly, the atmosphere surrounding the fish would soon be charged with moisture to such an extent as to prevent any further evaporations, and the fish, too, would be injured by being warmed for too long a time or too thoroughly. The currents of fresh air which alternate with the heating process described serve to bring down the temperature of the fish and also to carry off the moisture-laden atmosphere which surrounds the fish, bringing into action fresh air which is ready to be charged with new moisture carried away from the fish by the next heating process.

The following account of the application of the Whitman process to curing codfish is abridged from a report made by the owners of the patent in the United States:

The first apparatus for practical working of the Whitman process was put up by the patentee at Annapolis, Nova Scotia, in a building 40 by 80 feet of 2½ stories. This fish-drying establishment has been in constant active operation for four years, and has turned out from the green and kench-salted fish about 10,000 to 15,000 quintals of dry fish annually for export to West Indies, Central and South America, and long-voyage tropical fish markets with very profitable results, giving employment to large numbers of men and fishermen, causing a large increase in Bay of Fundy hake and haddock fishing, and a steady advance in prices, till now these fish are actually commanding higher prices at the Bay of Fundy ports of Nova Scotia than the hake taken by United States fishermen off the New England coast are selling at in Gloucester or Boston; all this being the result of drying the fish suitably for tropical markets, which it has been found impossible to do in the ordinary way by the sun, owing to the humidity of the atmosphere and prevalence of fogs on the Nova Scotia and New England coasts. The same successful results have followed with all the fish-driers Mr. Whitman has had erected for his own account or for others at Halifax, Nova Scotia.

At St. Johns, Newfoundland, for Messrs. Bowring Bros., and for Messrs. Job Bros. & Co., two of the largest fish-exporting firms in America, these drying establishments have been in active operation almost constantly, night and day, since erected, about three years ago, and Messrs. Bowring Bros. have purchased Mr. Whitman's patent right for the island of Newfoundland and dependencies of Labrador.

At St. Pierre, Miquelon, under Mr. Whitman's French patent in 1897, he erected a drier for Messrs. Beust & fils, of Granville, France, who have a large fish establishment at St. Pierre and a fleet of vessels employed in fishing on the Grand Banks of Newfoundland. This drier they operate on a royalty, and have made a good success of it, drying fish for export to Madagascar and other French colonies in tropical countries, which it was impossible to do on the Newfoundland coast in open air, owing to humid climate and fog. At Paspibeac, Quebec, Canada, Mr. Whitman erected for Messrs. Charles Robin, Collas & Co., Ltd., an extensive drier, costing $5,000, which has been most successfully operated for two years past by Charles Robin, Collas & Co., who, only two months after they had commenced operations, bought of Mr. Whitman the patent rights for the Province of Quebec and Baie de Chaleur coast and paid £1,000 in cash.

A small drier was erected at Halifax, in 1896, for Messrs. Geo. E. Boake & Co., especially to dry fish for their Jamaica trade, which has been in constant use over two years and proved a great success in saving of time and labor. At Halifax Mr. Whitman erected, in 1895, a large drier building, 60 by 120 feet, which has been in very successful operation ever since, and has enabled his company to open up large and profitable fish markets in Central and South America, formerly largely controlled by Norwegian fish-dealers. Mr. Whitman is now erecting a fish-drier at Gloucester for Messrs. John Pew & Son, and is about to organize a joint-stock company to operate a large drier at Boston, not only to dry fish for the cutting and other branches of the domestic trade, but for export fish trade.

A correspondent writes as follows in the Yarmouth *Herald* of July 18, 1893, respecting the success of Mr. Whitman's fish-drying apparatus at Halifax:

Within the last few days I have had the privilege of visiting the extensive new fish-drying apparatus that has been put in operation in this city (Halifax) by the inventor, Mr. Thomas S. Whitman, of Annapolis. The building containing the apparatus and storage rooms has been constructed and completed and operations have commenced within the last month. It is a very large building, 50 by 120 feet, and is situated on Liverpool wharf, where there is ample wharfage, and where a large amount of fish can be taken care of. Entering the building a very busy scene meets the eye; thousands of quintals of fish are seen in the various processes of washing, drying, and packing for the largest fish markets in the world. I was particularly struck with the rapidity of the operation. Mr. Whitman buys all the green-salted fish that offers; by his process they are dried perfectly in 48 hours, and are ready to ship in less than a week from kenching. It is certainly a new departure in the handling and curing of fish. The new system invented and introduced by Mr. Whitman is a perfect drier, and at the same time the fish are so kept apart from each other during the entire process of drying that they are also kept cool, the atmosphere by which they are dried being of about the same temperature required in the natural system of drying. It is astonishing to note the vast quantities of fish that can be cured in a short time; several thousand quintals per week is the capacity of this large concern, and it is certainly a busy hive of industry, one of the busiest in the provinces. To-day your correspondent was shown about 8,000 quintals of fish that were being dried, and most of them were in the sea only a short time ago, and before the week closes they will be shipped in perfect order to the fish markets of the West Indies. Considering the large amount of foggy, wet weather that the people of the western counties generally have to meet during their fish-drying season, it would evidently be to the advantage of our largest fish-packers if they were to adopt the methods now used and invented by Mr. Whitman, for it is evident that a vast amount of time is thus saved in the curing of fish, while the uniformity of the curing is maintained throughout, every fish appearing in perfect order as a result of this process. As I stated before, it only required 48 hours to thoroughly dry the fish, and they are then ready for shipment to any part of the world.

It is estimated that the cost of drying codfish by the Whitman process from the water-horse to the finished product is about 30 or 35 cents per 112 pounds for fish suitable for the West India trade, this covering two dryings of 24 hours each and a sweating of 10 to 12 days. In preparing fish for Central America or northern Brazil, 2½ days' drying is necessary, and the cost approximates 40 or 45 cents, while for southern Brazil the fish must be dried for 3 days by the Whitman process, and the cost is about 45 or 50 cents per quintal of 112 pounds.

A number of other processes of artificial drying have been devised, but none of them have been adopted to any extent by the trade.

DRESSING AND SALTING MACKEREL ON BOARD VESSEL IN GLOUCESTER HARBOR.

PRESERVATION OF FISHERY PRODUCTS BY PICKLING.

Pickling foods consists in their preservation and subsequent retention in some antiseptic flavoring solution, such as brine, vinegar, etc. Brine made of common salt is used almost exclusively in pickling fish, while for mollusks, crustaceans, and a few preparations of fish, vinegar with certain spices added is generally employed; but pickling with vinegar is of small importance compared with brine-salting.

A variety of flavoring solutions used for pickling in foreign countries are comparatively unknown in the United States. In Japan small fish are frequently boiled and placed in *shoyu* or *soja*, a sauce made from fermented wheat, beans, and salt. In the same country salmon, cuttlefish, etc., are frequently slightly salted and then boiled and placed in a tight package with rice partly fermented, the development of the ferment being checked by the removal of moisture. The rice, taking moisture from the fish, begins again to ferment and the fish imbibes products of the fermentation, such as dextrine, sugar, and alcohol, and is thereby very delicately flavored.

A number of other antiseptics have been introduced for the purpose of preserving food products, among which are boracic acid, salicylic acid, etc., but as these do not flavor the product, and as they are not generally employed as a solution, their use is not considered as pickling. A discussion of them is therefore reserved for the last chapter of this report, the present chapter dealing with methods of pickling with brine and vinegar.

DEVELOPMENT AND METHODS OF BRINE-SALTING.

The origin of pickling fish with salt is of somewhat uncertain date. It was known to the Phœnicians on the Spanish coast, and was employed by the Greeks to some extent, and the Romans carried it to a high degree of perfection, especially in preserving swordfish from Sicily, tunny from Byzantium and Cadiz, mackerel from Spain, and mullet from Exone. Brine-salting received its greatest development during the thirteenth and fourteenth centuries at the hands of the Dutch in preserving herring caught in the North Sea, and since that time it has become one of the most important methods of preserving fish. Its principal application in the United States is in the preservation of mackerel, herring, alewives, salmon, mullet, cod, lake trout, whitefish, bluefish, shad, etc. It is also used in preserving certain miscellaneous products, as cod tongues, halibut fins, sturgeon eggs, mullet eggs, etc.

The general method of brine-salting is to dress the fish and place them with salt in tight vats or barrels, the salt uniting with the moisture in the fish forming a pickle, in which they remain for a few days until cured, after which they are usually removed and placed in market packages with new brine. But there are many exceptions to this practice, depending on the species of fish and the markets for which they are intended. Some fish, sea herring and river herring, for instance, are usually not dressed at all, being brine-salted in the natural or round condition. Others are gibbed, or split to the vent and eviscerated. But most pickled fish are split either on the back or the belly from the head to the tail, so as to lay out flat; some have the heads removed, and a few have a large portion of the backbone cut out.

However they may be dressed, it is important that the fish be salted as soon as practicable after removal from the water—in the meantime being protected from the sun, from bruising, etc. In case the fish have been dressed they are usually washed and soaked to remove all the blood. In salting, the fish are placed in the barrels or butts, with dry salt sprinkled among them, the quantity used ranging from 20 to 25 pounds to 100 pounds of fish. On the New England coast Trapani salt is generally used, except in the case of mackerel and one or two other species, for which Liverpool salt is preferred. On the Great Lakes, Syracuse and Warsaw salts are preferred, but the other kinds are used to some extent. Along the Middle and South Atlantic coast Liverpool salt is usually employed. The dry salt unites with the moisture in the fish, making a pickle which soon strikes through the fish. If thin, dry fish are being cured, it is sometimes well to add strong brine to aid in forming the pickle.

After a time, averaging for most species about a week or ten days, the fish are cured, and should then be placed in packages suitable for the market with additional salt sprinkled among the fish, and the package completely filled with strong brine. The principal difficulty encountered is the liability of the fish to rust; but by using strong pickle and tight barrels, so that the fish are covered with pickle all the time, this tendency may be easily overcome except during very warm weather.

The quantity of salt used in pickling fish varies according to the size and condition of the species handled, and experience and knowledge of the particular market for which they are intended are the best guides in every instance. A mild-cured fish is preferred to one heavily salted; but if too little salt is used the pickle is likely to slime or sour and the fish become rusty. It is therefore usually desirable to err on the side of too much salt rather than too little. Occasionally, to insure perfect preservation, it is necessary to use so much that the flavor of delicate species is more or less injured. Sugar is sometimes employed to modify the action of the salt and to improve the flavor of the articles pickled when it is not desired to keep the product for a considerable length of time, as in case of pickling salmon. But the use of sugar is sometimes attended with fermentation unless the pickled products be kept at a low temperature; and glucose is now sometimes substituted. The fish are first struck in salt and then packed in a suitable receptacle with a solution composed of about 3 pounds of glucose, 10 pounds of salt, and 5 gallons of water, the glucose being dissolved in the water before the salt is added.

Pickled fish are placed in a great variety of packages adapted to the trade for which they are intended and ranging in capacity from tierces, each containing 300 pounds, to small kegs containing only a pound. Mackerel, sea herring, salmon, cod, and the like, are mostly put up in whole barrels of 200-pounds net capacity. River herring or alewives are generally placed in 160-pound barrels, while the bulk of mullet, lake herring, whitefish, trout, and other lake species are usually packed in half-barrels of 100 pounds capacity. Most of these species, however, are also placed in packages varying from 50 pounds to 10 pounds, suitable for the various requirements of the retail trade, each package being branded with the weight of the fish therein.

Carefulness in the selection of the packages is of great importance. Those used on the New England coast are manufactured mostly in Maine, Bangor being the center of the industry, and the 100-pound barrels or half-barrels used on the Great Lakes are made principally at Sandusky; but while the products of those two cities are the standards, many fish barrels are made at various other points. Wood which imparts a peculiar flavor to the fish should not be used for making the barrels, unless

for preparing fish for those markets which exhibit a preference for fish having such a flavor. The staves and heads may be of white pine, white or red oak, spruce, poplar, or chestnut, and they are sent to the fishing ports either ready for use or, to economize freight, in shooks ready to be put together. The Bangor barrel has staves 28 inches in length and the heads 17 inches between the chimes, and is bound with 3 hoops on each bilge and the same number on each chime. In packing valuable fish, such as mackerel, much stouter barrels are necessary than when packing herring, for instance. The average cost of the Bangor barrel used in the mackerel trade approximates 55 cents, and the Sandusky barrel costs about 50 cents.

REGULATIONS RESPECTING BRINE-SALTING FISH.

With a view to maintaining the reputation of the output, and incidentally to preventing fraud on the consumers, statutes affecting the packing of brine-salted fish have been enacted in several of the States, especially in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, North Carolina, and Ohio. The pickling of mackerel is regulated in Maine, New Hampshire, Massachusetts, and Rhode Island. The laws of Connecticut attempt to regulate the pickling of shad. In Ohio it is required that all pickled fish be inspected except herring, mackerel, and shad; also in Chicago and some other large cities there are municipal regulations relative to the same matter. Few of the State or municipal regulations are strictly enforced; and since there are no national laws protecting inspected fish after leaving the jurisdiction of the State where packed, it frequently happens that fish inspected and uniformly graded according to the regulations of the State where prepared are repacked in other States and sold with short weights and under wrong grades, low-grade fish being sold for choice ones, short fish for long, and even herring for mackerel, much to the injury of the trade. There is nothing to prevent mackerel, for instance, which has been pickled and inspected in accordance with the regulations of Maine or Massachusetts, from being repacked and sold under false brands.

A barrel of fish signifies 200 pounds of fish exclusive of pickle, but without proper inspection many dealers are disposed to place less than that weight of fish, adding brine to keep the gross weight of the barrel's contents the same. The faulty grading of fish is much more frequently practiced, fish improperly cured or those of small size being branded higher than the quality or size warrants. This is the principal reason why so large a proportion of the pickled herring sold in this country are of foreign importation; many dealers preferring to handle those cured and packed under careful foreign inspection, even though the cost be nearly twice as great, since the brand indicates exactly what they are buying.

Inspection regulations are of very early origin, those in Massachusetts dating from 1651. They generally provide for inspectors, who are appointed by the governor or chosen by the towns in which they are to serve. There was an inspector-general in Maine prior to 1875, but the office was abolished that year, and at present the governor is required to "appoint, in places where pickled fish are cured or packed for exportation, one or more persons, skilled in the quality of the same, to be inspectors of fish, who shall hold their office for a term of five years, unless sooner removed by the governor and council."

The regulation in New Hampshire respecting the appointment of inspectors is almost identical with that of Massachusetts. The inspector-general is appointed by the governor, with the advice and consent of the council, for the term of five

years, unless sooner removed. He may appoint deputy inspectors, removable at his pleasure, in every town where fish are packed for exportation.

In Rhode Island "the electors in each town shall, annually, on their town election days, choose and elect * * * one or more packers of fish."

In Connecticut "the superior court in the several counties may appoint in each town therein not exceeding 15 inspectors and packers of fish."

In each of these States the inspectors are required to give a bond for the faithful performance of their duties, the amount of the bond ranging from $10,000, in case of the inspector-general of Massachusetts, to $100 for the local inspectors in Connecticut. Their duties consist generally in inspecting and branding the fish salted under their supervision, and the fees are: In Maine, 7 cents per barrel; in New Hampshire and Massachusetts, 9 cents, of which 1 cent per barrel goes to the inspector-general. In Rhode Island "the packers [inspectors] of fish shall be paid for opening, assorting, inspecting, weighing, pickling, packing or repacking, heading up, nailing, and giving a certificate, if pickled codfish or mackerel, 20 cents for every barrel, and 15 cents for every half-barrel * * *; and for all other, except codfish and mackerel, * * * 25 cents for every cask." The Connecticut inspectors receive "for packing, heading, plugging, pickling, and branding each barrel of fish 20 cents, and for each half barrel 10 cents."

While the foregoing are the fees fixed by law, yet generally, as there is no limit to the number of inspectors, each packing house has one as a member of the firm or employed in some capacity, so that the local fees are rarely paid.

The inspection in Maine is made under the following provisions:

Every inspector who inspects any kind of fish that are split or pickled for packing, shall see that they are in the first instance free from taint, rust, or damage, and well struck with salt or pickle; and such of said fish as are in good order and of good quality shall be pickled in tierces, barrels, half-barrels, quarter-barrels, and tenths of barrels, or kits; each tierce containing 300 pounds, each barrel 200 pounds, and so on in that proportion; and the same shall be packed in good clean coarse salt, sufficient for their preservation; and then each cask shall be headed up and filled with clear, strong pickle, and shall be branded by the inspector with the name and quality of the fish therein. Mackerel of the best quality, not mutilated, measuring, when split, not less than 13 inches from the extremity of the head to the crotch or fork of the tail, free from taint, rust, or damage, shall be branded "number one"; the next best quality, being not less than 11 inches, measuring as aforesaid, free from taint, rust, or damage, shall be branded "number two"; those that remain after the above selection, free from taint or damage, and not less than 13 inches, measuring as aforesaid, shall be branded "number three, large"; those of the next inferior quality, free from taint or damage, not less than 10 inches, measured as aforesaid, shall be branded "number three"; all other mackerel, free from taint or damage, shall be branded "number three, small." The inspector shall brand, in plain letters, on the head of every such cask, the weight, the initials of his Christian name, the whole of his surname, the name of his town, and the letters "Me." an abridgment of the month and the year, in figures, when packed.

Every inspector who inspects pickled alewives or herring, packed whole or round, shall see that they are struck with salt or pickle, and then put in good casks of the size and material aforesaid, packed closely therein and well salted, and the casks filled with fish and salt, putting no more salt with the fish than is necessary for their preservation; and the inspector shall brand all such casks with the name of the inspected fish as aforesaid, but in no case shall the inspector brand the casks unless the fish contained therein shall have been packed and prepared under his immediate supervision.

All tierces, barrels, and casks which are used for the purpose of packing pickled fish shall be made of sound, well-seasoned white oak, white ash, spruce, pine, chestnut, or poplar staves, with heading of either of such kinds of wood, sound, well planed and seasoned, and when of pine to be free of sap, and the barrels to be hooped with at least three strong hoops on each bilge and three also on each chime; the barrel staves to be 28 inches in length, and the heads to be 17 inches between the chimes, and made in a workmanlike manner to hold pickle.

If any person takes from a cask any fish pickled, cured, lawfully inspected and branded, and substitutes therefor or fraudulently intermixes other fish; or any inspector marks any cask out of his town, or which he has not inspected, packed, and prepared himself according to law; permits other

persons unlawfully to use his brands, or willfully and fraudulently uses the same himself after the expiration of his commission, he shall forfeit $20 for each cask or box so dealt with.

If any person lades or receives on board any vessel or other carriage, for any transportation from this State, any pickled fish, or cured or salted whole fish, packed or not packed, not inspected and branded as aforesaid, except such as is described in the exception of section 13, he shall forfeit at the rate of not less than $5 nor more than $10 for every 100 pounds thereof; and any justice of the peace may issue his warrant to the proper officer, directing him to seize and secure any such prohibited fish, and convey it to any inspector within a convenient distance for inspection; and every person refusing to give necessary aid in the service of such warrant, when required by the officer, shall forfeit $5 to the person suing therefor in an action of debt; and such inspector shall open, inspect, pack, and brand such fish according to law and detain the same till all lawful charges of seizure and inspection are paid.

The fish inspection laws of New Hampshire follow very closely those of Maine.

The inspection laws of Massachusetts date from 1651, but have been modified from time to time. The following are among the principal provisions at present:

Under the supervision of the inspector-general and his deputies, respectively, all kinds of split pickled fish and fish for barreling except herrings, and all codfish tongues and sounds, halibut fins and napes, and swordfish, whenever said articles are intended for exportation, shall be struck with salt or pickle in the first instance, and preserved sweet and free from rust, taint, or damage; and when the same are found in good order and of good quality they shall be packed either in tierces containing each 300 pounds, in barrels containing each 200 pounds, in half-barrels containing each 100 pounds, or in packages containing each less than 100 pounds, on which the number of pounds therein shall be plainly and legibly branded. Every cask, kit, or package shall be packed with good, clean salt suitable for the purpose, and, after packing with sufficient salt to preserve its contents, shall be headed or well secured, and filled up with a clean, strong pickle.

Casks used for packing or repacking pickled fish intended for exportation, except casks containing less than 25 pounds weight, shall be made of sound, well-seasoned white oak, ash, red oak, spruce, pine, or chestnut staves of rift timber, sound and well seasoned, with heading of either of said kinds of wood, and when of pine such heading shall be free from sap and knots and be planed. The barrels, half-barrels, and tierces shall be well hooped with at least three good hoops of sufficient substance on each bilge and three hoops of the like quality on each chime. The barrel staves shall be 28 inches in length and the heads shall be 17 inches between the chimes. The barrels shall contain not less than 28 nor more than 29 gallons each; the half-barrels not less than 15 gallons each; and the tierces not less than 45 nor more than 46 gallons each. Each cask shall be made in a workmanlike manner, and branded on its side, near the bung, with the name of the maker.

There shall be five qualities of mackerel, three of salmon and shad, and two of other kinds of pickled fish. Mackerel of the best quality, not mutilated, measuring not less than 13 inches from the extremity of the head to the crotch or fork of the tail, free from rust, taint, or damage, shall be branded "number one." The next best quality, being not less than 11 inches, measuring as aforesaid, free from rust, taint, or damage, shall be branded "number two." Those that remain after the above selections, if free from taint or damage, and not less than 13 inches, measuring as aforesaid, shall be branded "number three, large." Those of the next inferior quality, free from taint or damage, not less than 10 inches in length as aforesaid, shall be branded "number three." All other mackerel free from taint or damage shall be branded "number four." Those salmon and shad which are of the best quality for family use, free from rust or damage, shall be selected for "number one" and "number two," the best of them selected and branded "number one," the residue "number two"; all that remain free from taint, and sound, shall be branded "number three." Of all other pickled fish the best, which are free from taint and damage, shall be branded "number one"; those that remain, free from taint and sound, "number two."

Each cask, kit, or package shall be filled with fish of the same kind or parts of the same kind of fish, and whoever intermixes, takes out, or shifts any inspected fish which are packed or branded as aforesaid, or puts in other fish for sale or exportation, shall forfeit $15 for each package so altered. If any casualty renders it necessary to repack a cask of inspected fish it shall in all cases be done by an inspector of such fish.

The inspector shall brand, in plain, legible letters, on the head of each cask of fish inspected by him, the denomination of the fish packed or repacked therein, the initials of his Christian name, and the whole of his surname; and, if a deputy, the name of the place for which he is appointed, the letters

"Mass.," and the year in which the fish are packed; and shall also, when in his judgment it may be necessary, nail in a suitable manner any cask in which fish are packed. Pickled fish duly inspected in the State or country in which it is packed shall not be subject to reinspection in this State.

Small fish, which are usually packed whole with dry salt or pickle, shall be put in good casks of the size and materials required in this chapter for the packing of split pickled fish, and shall be packed close in the cask and well salted. The casks shall be filled full with the fish and salt, and no more salt shall be put with the fish than is necessary for their preservation, and the casks containing such whole fish shall be branded with the denomination of the fish, and a like designation of the qualities as is before described in this chapter in respect to the qualities of other pickled fish.

In Rhode Island provision is made for the election annually of one or more packers of fish in each town, who shall see that all fish packed in the State are properly pickled and repacked in casks in good shipping order, with good salt, sufficient in each cask to preserve such fish from damage, to any foreign port. Other provisions of the law are as follows:

Pickled fish, whether codfish, mackerel, menhaden, herrings, or other fish, shall be sorted and one kind only be put into one cask.

Every cask shall be well seasoned and bound with 12 hoops; those of menhaden and herrings of the capacity to hold 28 gallons, and those for other fish of the capacity, if a barrel, to hold 200 pounds, and if a half-barrel, 100 pounds weight of fish; each cask to be full, and the fish sound and well cured.

Every cask being first searched, examined, and approved by a packer shall, when packed or repacked for exportation, be branded legibly on one head with the kind of fish it contains and the weight thereof; or the capacity of the cask, with the first letter of the Christian and the whole of the surname of the packer, with the name of the town, and with the words "Rhode Island" in letters not less than three-fourths of an inch long, to denote that the same is merchantable and in good order for exportation.

Every cask of pickled codfish and mackerel offered for sale or for exportation from this State shall also be branded "No. 1," "No. 2," or "No. 3," to denote the quality of such fish.

Nothing in this chapter contained shall hinder any fisherman or owners of fish coming to this State from their fishing trips from selling or reshipping their fish to any other of the United States without being packed into barrels or half-barrels.

Connecticut regulations for the inspection of pickled fish relate especially to the curing of shad, and since none of those fish are now pickled in that State except for home consumption the regulations are inoperative. The pickled-fish inspection laws of other States are either inoperative or they relate to certain species, and will be noted in the account of the methods of preserving those particular products.

BRINE-SALTED MACKEREL.

In the preparation of few marine products in this country are such nice distinctions made as in pickling or brine-salting mackerel. Not only has the work been reduced almost to a science by the fishermen and dealers, but it has been surrounded with a mass of legislation qualifying the manner of preparation almost without a parallel in the preservation of food products. Mackerel salting in the United States is confined almost entirely to Massachusetts and Maine, and four-fifths of the product is prepared in the first-named State, Gloucester and Boston being the principal centers of the trade. A few barrels are prepared also in New Hampshire, Rhode Island, and Connecticut.

The pickling of mackerel was of but little extent prior to the beginning of the present century, the annual product on the entire coast previous to 1816 rarely exceeding 15,000 barrels. The first salt-mackerel trip from Gloucester is said to have been made by the schooner *President* to Cashes Ledge, in the Gulf of Maine, about 1819. From that time to 1831 the industry rapidly increased, the output of Maine, New Hampshire, and Massachusetts during the last-named year reaching 449,950 barrels,

the largest product in the history of the fishery. The value of the yield during that year was $1,862,793, while the value of the 324,454 barrels packed in those States in 1864 reached $7,001,098. In 1881 the yield was 391,657 barrels, with a reported valuation of $2,447,556. The increasing demand for fresh fish in this country has affected the trade in salt mackerel, a much smaller proportion of the catch being salted during recent years than formerly. Of the 131,939,255 pounds of mackerel taken in the United States fisheries in 1880, 80 per cent was salted, whereas during very recent years the salted mackerel represents less than half of the total yield. The quantity of these fish caught has also decreased greatly, so that at present the trade in salt mackerel is very much less than it was fifteen years ago. In 1887 the domestic product was 93,582 barrels, valued at $1,064,124; in 1890 it decreased to 20,742 barrels, worth $306,731; while in 1892 it numbered 46,946 barrels, worth $611,486. The yield was 24,939 barrels in 1895, 77,464 barrels in 1896, 13,154 barrels in 1897, and 14,286 barrels in 1898, less than 5 per cent of the annual average during the 40 years preceding 1886.

During the last thirty years quantities of salted mackerel have been prepared in the British North American Provinces, the annual product during the past three or four years averaging about 25,000 barrels. The mackerel taken on the coasts of Europe are generally sold fresh, but in Ireland, Norway, England, and Scotland many barrels are salted each year, especially in Ireland. Of the 399,361 barrels taken in those four countries in 1895, 46,500 barrels were salted, nearly all of which found a market in America. In 1897 the European product of salt mackerel was 57,352 barrels, and in 1898 it approximated 50,000 barrels. The European method of salting mackerel was until recently considered somewhat inferior to that in vogue in the United States, differing from the American method principally in that the fish were split down the belly instead of down the back, they were not soaked to remove the blood, and in packing in the barrel they were placed face up. The packers, however, have rectified these mistakes and the foreign mackerel are at present more carefully prepared than formerly, and those received in this country from Ireland and Norway now compare very favorably with the domestic product.

The domestic mackerel that find their way into the salt-fish trade are taken principally in purse-seines, most of those caught by means of lines, gill nets, pound-nets, etc., being marketed fresh. When salted, however, they are prepared in the same manner as those taken in purse seines, except that, the yield being usually much less in quantity, facilities for handling the fish rapidly are not of so great importance.

Mackerel taken by seines or gill nets do not usually keep so well when salted as those taken by lines, as the latter are taken in smaller quantities and greater care can be used in handling them, and they may be readily salted before deterioration begins and very shortly after being removed from the water.

The methods of salting as here given relate especially to fish taken by purse seines.

When the fish are removed from the seine by means of a large dip net they are thrown on deck; or, if the catch be large, they are placed in a "pocket" or "spiller," rigged along the side of the vessel, where they can be kept alive until the crew have time to dress and salt them. So many fish are sometimes taken at a single haul that if at once removed to the deck many would spoil before the fishermen could properly care for them, and the purpose of the pocket is to provide a receptacle in which fish may be kept alive for several hours. This pocket was introduced in 1877 in a simple form on the schooner *Alice*, of Swan Island. An improved form was invented by H. E. Willard, of Portland, Me., and patented in April, 1881, but valuable improvements and

modifications have been made in its construction since that time. The following is a description:

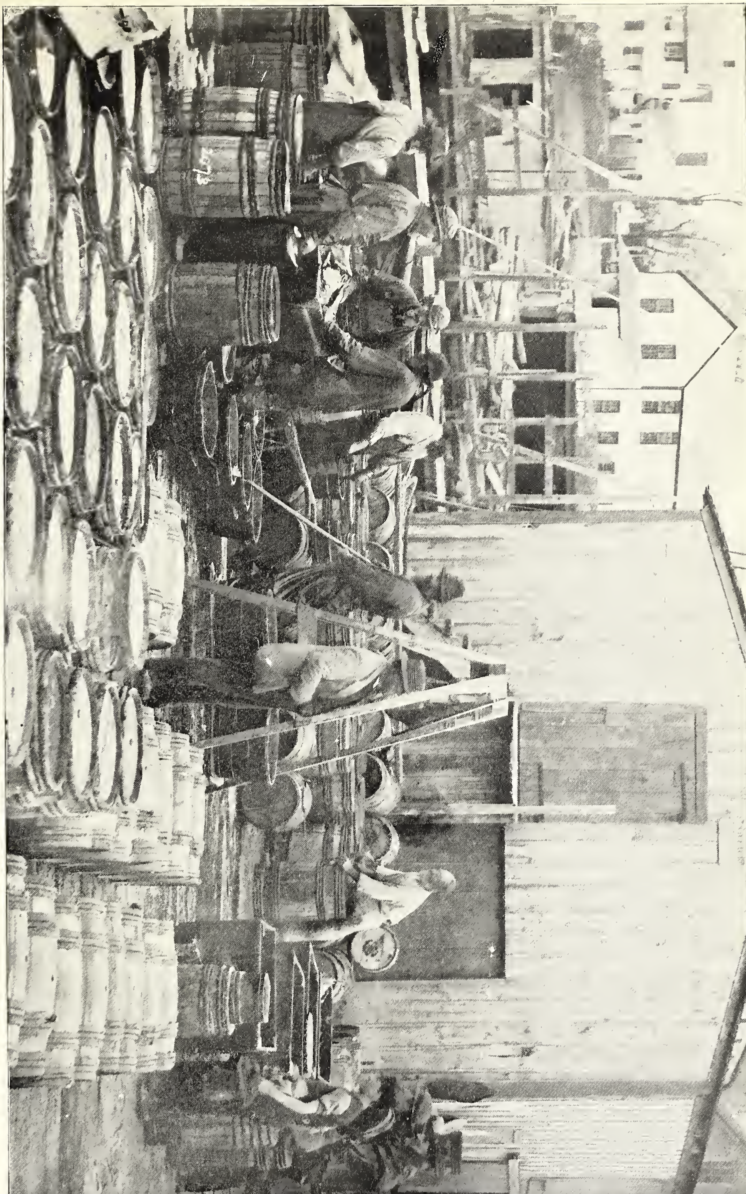
The mackerel pocket is a large rectangular net bag, usually 36 feet long, 15 feet wide, and 30 feet deep, with 2-inch mesh, hung to 1¼-inch rope. On the portion of the rope next to the vessel wooden floats are strung for the purpose of securing the edge of the pocket to the rail of the vessel, this edge being fastened over the rail and between it and a board held in position by wooden pins. The outer corners of the pocket are supported by ropes running through blocks attached to outriggers 4 inches in diameter, by means of which the outer edge of the pocket may be elevated or depressed. To the outer edge of the pocket is attached a rope bridle, the ends of which are fastened about 9 feet from each outrigger. A thimble is attached to the middle of this bridle, and when the mackerel have been turned into the pocket the fore and after staysail halyards are bent into the thimble and the outer edge of the pocket thus supported and the outriggers relieved from considerable strain. In getting the fish into the pocket the latter is slacked down to the surface of the water and the outer edge is fastened to the cork rope of the seine. By gathering the twine of the seine, beginning at the side farthest from the pocket, the fish are readily turned into the pocket, and the edge of the latter is then raised above the surface of the water.

Unfortunately the fishermen have found little use for these pockets during the last six years, the catch of mackerel being so small that they can be readily cared for before any of them spoil. The fish are removed from the pocket in quantities ranging from 25 to 100 barrels at a time. If the weather be warm and moderate the quantity removed at a time is small, but when the air is cool or the water rough or when dogfish are abundant the quantity is very much larger.

For dressing the fish, the crew is divided into working gangs of three men each, one of whom splits and the other two, known as "gibbers," gill and eviscerate the fish. Each gang of men is provided with a splitting board from 6 to 10 inches wide and with two wooden trays about 3 feet square and 6 inches deep, which are generally supported on the tops of barrels. Some crews, especially in the hand-line fishery, have only two men in each splitting gang, the splitter or some one else getting the barrels, filling them with water, and otherwise aiding the gibber. The splitter with his left hand, which is usually covered with a cotton mitten for protection as well as to prevent the fish from slipping, takes the fish round the center of the body, with the tail toward him, and splits it down the back on the left side of the backbone from the head to the tail, so that it will lie open and flat after the viscera have been removed, the knife being held by the fingers and guided by the thumb sliding along the upper side of the fish. On splitting each fish he tosses it to the tray of the gibber, who, with hands covered with gloves to protect them against the bones, opens the fish with a jerk, causing it to break lengthwise along the lower end of the ribs if it is fat, thus making a crease on each side. He removes the viscera and gills and throws the fish, open and face down, into a barrel partly filled with clean salt water, in which the blood is soaked from the fish, whence they are called "wash barrels." There the fish remain until the splitting is finished, which may be 6 or 8 hours or even longer after the first fish have been split. Then the deck is cleaned up and the men proceed to salting.

A good splitter can handle from 2,000 to 3,500 mackerel per hour, and under favorable circumstances 200 barrels of mackerel can be cared for by a crew of 12 or 15 men without difficulty before any of them spoil. Sometimes, when a large haul has been made, the crew may work steadily for 24 or even 36 hours in succession, losing only the brief time given to meals. By practice they can split and dress the fish as well at night as during the day.

If the men have time they "plow" or ream the fish, making a cut in the abdominal cavity on each side near the backbone, in imitation of the natural cracks or breaks



SALTING, WEIGHING, AND PACKING MACKEREL ON NEW ENGLAND COAST.

which occur in fat fish, thus giving the fish a fat appearance. "Plowing" was begun about 1830, and although for a number of years there was great opposition to the innovation, it is at the present time recognized as a legitimate feature of the trade. The fatness of mackerel as well as the size determines the quality, and the degree of fatness is most readily ascertained by noting the portions covering the abdominal cavity. When the fish is very fat these portions crack open about halfway from the backbone to the center of the abdominal cavity, and the depth of these cracks indicates the relative fatness of the fish. By making the break or crack nearer to the backbone than where it would ordinarily occur and where the flesh is considerably thicker, the fish is given the appearance of being much fatter than it really is. At first these cracks were made by using the thumb nail, and later by the back of the point of the splitting knife, the cut by degrees being made higher than it naturally belonged. The use of the knife led gradually to the introduction of the plow or reamer, of which there are many styles, some made wholly of wood, others with the end tipped with pewter and with fine teeth on the edge, so as to make the crease rough, as though it were broken naturally. A popular form consists of a small cutting blade about 1½ inches in length, cut square forward and tapering to a point at the heel, attached to a curved iron shank, to which a wooden handle is fixed.

In salting, the mackerel are emptied from the wash barrels upon the deck and rinsed by throwing buckets of water over them. A man places them, a few at a time, on a gib tub containing a half bushel or more of No. 2 Liverpool salt, while another man, taking a fish in each hand, rubs the flesh side of the fish in the salt and, with the back of one fish against the flesh of the other, places them in the sea barrel with the flesh side down, except that the two or three bottom layers or tiers have the flesh side up. Formerly it was customary to place all the fish with flesh side up, but this has been abandoned. The salt is carried in the hold in barrels that are subsequently used for packing the mackerel. Liverpool salt is used almost wholly, Cadiz and other coarse salts having a tendency to tear and give a ragged appearance to the mackerel. It is quite important that every portion of the surface of the fish be in contact with the salt, and care should be taken not to leave finger marks where the fingers or thumb cover portions of the fish during the process of salting and prevent the access of salt.

Formerly on some vessels, especially those from Cape Cod, the mackerel were not rubbed in the salt, but were placed in the barrel with the flesh side up and the salt scattered over them. In salting the fish in that manner, Cadiz salt was used principally. The present method is much more rapid and leaves the fish in much neater condition, because the coarse salt pressing against the fish indents and lacerates it. By either process a barrel of mackerel may be salted in from 8 to 15 minutes, about a bushel of salt being used. After standing for a day or so and settling, the barrels are topped up by adding more struck fish to each barrel. When convenient, the barrels are headed and stowed in the hold or secured on deck until the vessel reaches port.

On arrival at port the barrels of mackerel are removed and placed on the wharf or in a storehouse until opportunity arises for repacking them, which may not be for months. Then the top of the barrel is removed, the brine poured off and discarded, the fish emptied out, several barrels at a time, into a culling crib or box of planed boards with slat bottom and usually 5 feet long, 3 feet wide, and 8 to 10 inches deep, placed on legs about 3 feet high. The fish are there culled into the several grades recognized by the trade and thrown into two weighing tubs, each holding about 100

pounds, which rest on a beam scale. These tubs have wooden staves and have the bottom perforated with inch holes to permit drainage, or, better still, a rope net-work bottom, and are bound with two iron hoops and have an iron handle on each side. The diameter of the tub is 24 inches at the top and the height is about 15 inches. When the proper weight of fish is placed in the tubs the fish are removed to a packing crib, somewhat similar to the culling crib, and usually 38 inches long, 26 inches wide, and 14 inches deep, where they are packed in barrels or smaller packages, the various grades being kept separate from each other and placed in different packages.

In packing, a small quantity of salt is sprinkled in the bottom of the barrel, next two or more layers of fish, with the flesh side up and succeeding layers of fish with the back up. Over each layer of fish a large handful of salt is sprinkled, about 35 pounds being used for each barrel of fish, which is required by law to contain 200 pounds of mackerel, exclusive of the weight of the pickle; while half, quarter, and eighth barrels must contain proportionate quantities. The total shrinkage on salt mackerel from the round to the marketable state is about 33 per cent. After being filled the barrel is headed and moved to some appropriate place on the wharf or in the storehouse, where it is "pickled"; that is, a hole is bored in the side or head of the barrel and as much brine as the barrel will contain is poured in. This brine should be made quite strong, at least of 95° salinometer test, and it is conveniently introduced by means of a water bucket with a copper nozzle in the bottom, forming a funnel, the end of which is placed in the hole made in the side of the barrel, a vent on the side permitting the air to escape. The hole is then plugged up and the barrel turned on end and branded. The branding kettle most commonly used is of stout sheet iron, cylinder shaped, 9 inches in diameter and 12 inches high. A rod with a wooden handle at the top passes through the center of the kettle and furnishes the means for handling it. A charcoal fire is made in the kettle and when the brand, usually made of brass at the bottom, is sufficiently heated, the barrels are stamped with the legal inspection marks. Because of leakage and evaporation it is frequently necessary to add additional pickle to the barrel after it has stood several days, the deficiency being noted by the sound produced by striking the barrel with a stick.

The total cost of repacking mackerel, including barrels, salt, and all labor, from the time the fish are received from the vessel, ranges between $1.25 and $1.60 per barrel, depending on the market price for barrels, labor, etc.

The general average of cost approximates $1.44 per barrel, apportioned as follows:

Labor—weighing and culling	$0.25
Labor in packing	.10
Salt in packing	.10
Cooperage	.06
Repickling	.08
Bangor barrel	.55
Supervision, use of plant, etc	.30

The laws of most of the New England States require that the work of culling, weighing, packing, and pickling be all performed under the personal supervision of a State inspector, who places his brand on the head of each barrel or package, indicating the kind and grade of fish, name of inspector, name of town and State where packed, and date of packing. In Maine and New Hampshire it is necessary that the date include the month as well as the year in which the fish are packed, but in Massachusetts the year is deemed sufficient. If by becoming rusty, or the pickle leaking out, the fish require repacking, they must again be inspected. There is much difference in

the quality of mackerel taken during different seasons of the year. The early spring catch is generally very poor and shrinks considerably when salted. The fish increase in fatness as the season advances, and those taken during the fall usually improve in weight in pickle. Full-grown fresh mackerel measure 17 or 18 inches in length, but some over 20 inches and weighing 3 or 4 pounds are caught. The average length is about 12 inches and the weight a trifle less than a pound. Salted mackerel measure considerably less, due to the loss of the head and the slight shrinkage in salting.

The grades of salted mackerel are very carefully defined by the statutes of various New England States, and with little difference in one State from those in another. In Maine salted mackerel of the best quality, not mutilated, measuring, when split, not less than 13 inches from the extremity of the head to the fork of the tail, free from taint, rust, or damage, are branded as "number one"; the next best quality, being not less than 11 inches, measuring as aforesaid, free from taint, rust, or damage, are branded as "number two"; second quality mackerel, but free from taint or damage, and not less than 13 inches, are branded as "number three, large"; those of the same quality, not less than 10 inches in length, are branded as "number three," and all other mackerel, free from taint or damage, are branded as "number three, small." The grades required by the laws of New Hampshire and Massachusetts are almost identical with the aforegoing, except that in the last-named States the fish are branded as "number four" instead of "number three, small." The regulations of Rhode Island are somewhat indefinite in this particular, requiring merely that every cask of mackerel offered for sale or for exportation from the State shall be branded "number one," "number two," or "number three," to denote the quality of such fish.

In addition to the grades designated by law, packers of mackerel prepare special grades known as "extra ones," "extra twos," "bloaters," etc. Extra ones are superior in size and fatness to legal ones, and are sold at a much higher price; and the same difference exists between extra twos and legal twos. Bloaters are the choicest mackerel prepared, and only a few barrels are secured each season.

Mess mackerel are also prepared as an additional form of the other grades. These are principally the best and fattest mackerel that would pass as numbers one and two, with the heads and tails removed, and with the slime, etc., carefully brushed off before being repacked. There is an average loss of about 17 per cent in weight in preparing mess mackerel from the customary condition of pickled mackerel, but this varies considerably, depending on the size and degree of fatness of the fish.

The laws of most of the New England States regulate the character and size of the barrels in which pickled mackerel are packed and the materials of which they are made. The law of Maine requires all barrels and casks to be made of sound, well-seasoned white oak, white ash, spruce, pine, chestnut, or poplar staves, with heading of either of such kinds of wood, sound, well planed, and seasoned, and the barrel or cask to be hooped with at least three strong hoops on each bilge, and three also on each chime; the barrel staves to be 28 inches in length and the heads to be 17 inches between the chimes. In Massachusetts all packages, except those containing less than 25 pounds weight, must be made of white oak, ash, red oak, spruce, pine, or chestnut, and the number of the hoops and the size of the barrel staves and heads are the same as set forth in the Maine laws. In each State the barrel must hold between 28 and 29 gallons, and the half-barrel not less than 15 gallons, and the tierce between 45 and 46 gallons. The regulations in New Hampshire are identical with those of Massachusetts as to the quality of the material and dimensions of the barrel,

but require that it shall contain between 29 and 30 gallons. Each cask must be made in a workmanlike manner so as to hold pickle, and be branded on its side near the bung with the name of the maker.

Most of the barrels used for pickling mackerel are manufactured in Bangor, Me., but a few are made in various other parts of New England. The price is generally from $40 to $55 per 100, but when an unexpectedly large demand for them exists they sometimes sell as high as $1 each at the fishing port. Barrels once used are sometimes repaired and used over again, but this practice is not commendable.

For convenience in marketing, brine-salted mackerel are frequently placed in half, quarter, eighth, and sixteenth barrels, after they have been prepared in the regulation-size barrels. In recent years a considerable market has been developed for much smaller packages, and when the fish are sufficiently cheap, they are frequently put up in 5-pound and 3-pound tin cans, for a description of which see page 520.

The following summary, compiled from the files of the Gloucester papers, shows the fishermen's price per barrel of the principal grades of mackerel during the first week of September in each year from 1830 to 1898, representing generally the average for the year:

Year.	No. 1.	No. 2.	No. 3.	Year.	No. 1.	No. 2.	No. 3.	Year.	No. 1.	No. 2.	No. 3.
1830	$5.00	$4.50	$2.62	1853	$11.50	$9.50	$7.50	1876	$15.00	$6.75	$5.50
1831	5.75	4.75	2.62	1854	15.00	12.25	5.00	1877	16.50	12.50	8.00
1832	5.00	4.00	2.75	1855	19.00	11.00	6.25	1878	18.00	8.00	5.00
1833	5.72	4.72	2.85	1856	13.00	8.00	6.00	1879	16.00	5.00	3.00
1834	5.72	4.72	3.35	1857	15.00	12.50	8.50	1880	14.00	7.00	4.00
1835	7.00	6.00	4.00	1858	15.50	12.50	8.50	1881	14.00	6.00	4.00
1836	9.00	8.00	5.00	1859	14.50	12.59	8.50	1882	18.00	11.00	8.00
1837	7.75	6.50	4.12	1860	16.00	8.50	5.00	1883	20.00	14.00	10.50
1838	11.00	9.25	5.50	1861	8.50	4.50	2.75	1884	14.00	10.00	3.50
1839	12.50	10.50	7.00	1862	8.25	6.00	4.50	1885	13.75	5.75	3.75
1840	12.75	10.50	5.50	1863	14.00	9.25	6.50	1886	22.00	12.50	9.50
1841	12.00	10.00	6.00	1864	30.00	20.00	....	1887	17.50	14.00	11.00
1842	9.00	6.00	4.00	1865	22.00	15.00	9.75	1888	22.00	18.50	14.00
1843	10.12	8.12	6.00	1866	22.75	13.25	....	1889	28.00	25.00	17.00
1844	9.50	7.50	5.50	1867	17.00	12.25	7.50	1890	21.00	17.50	13.00
1845	13.00	10.50	6.87	1868	17.00	13.00	....	1891	18.00	13.00	8.00
1846	9.12	6.25	3.87	1869	23.00	11.50	....	1892	20.00	12.00	10.00
1847	12.75	8.25	4.25	1870	23.00	9.75	....	1893	16.50	14.00	12.00
1848	9.00	6.00	3.37	1871	11.25	7.25	6.25	1894	18.00	14.50	12.50
1849	12.00	7.00	3.50	1872	14.50	9.50	7.00	1895	20.00	....	....
1850	10.12	8.12	5.00	1873	20.00	12.25	9.00	1896	17.50	14.50	....
1851	10.00	6.50	5.12	1874	13.25	9.00	7.00	1897	16.00	....	....
1852	9.00	7.00	5.75	1875	16.25	10.25	7.50	1898	17.00	....	11.50

BRINE-SALTED HERRING.

Several different species of the Clupeidæ family are known locally in the United States as herring. The principal ones are the sea herring (*Clupea harengus*), so abundant in the Gulf of Maine; two kinds of alewife (*Pomolobus pseudoharengus* and *P. æstivalis*), known on many parts of the coast as river herring, and the herring of the Great Lakes (*Argyrosomus artedi*). The sea herring occurs north of Montauk, while the alewife inhabits the rivers and bays all along the Atlantic seaboard, the fishery being of the greatest importance in the tributaries of Chesapeake Bay and Albemarle Sound. The herring of northern Europe are of the same species as those of the New England coast.

In this report the name "herring" refers to the *Clupea harengus*, the other species being known as alewives or river herring and lake herring.

It is impossible to assign even an approximate date for the first salting or pickling

PLATE XXIV.

PICKLING AND BRANDING MACKEREL ON THE NEW ENGLAND COAST.

DRESSING AND BRINE-SALTING RIVER HERRING OR ALEWIVES ON THE NORTH CAROLINA COAST. (See page 450.)

of herring. Francis Day, in his well-known work on the Fishes of Great Britain and Ireland, parts V–IX, p. 222, writes as follows on this subject:

> At the beginning of the twelfth century there were herring fisheries in the Baltic, to which many foreign vessels resorted; these herring must, therefore, have been *salted;* in fact, in 1155 Louis VII, of France, prohibited his subjects purchasing anything but mackerel and salted herrings at Estampes.

The manner of curing these fish is considered to have been very crude until the time of William Beuckels, or Beuckelzon, a fish merchant of Biervliet, in Flanders, who, during the fourteenth century, greatly improved the methods in use and laid the foundation of the great wealth acquired later by Holland in this business. Beuckelzon died in 1397, and a monument was erected to his memory by Charles V in his native village, Borgo; while Mary of Hungary, during a visit to the Low Countries, is said to have paid a more characteristic tribute to his memory, namely, that of eating a salt herring at his tomb.

The first mention we have of pickled herring in America is by Josselyn, in the seventeenth century, who, in his Chronological Observations of America, says: "We used to qualify a pickled herring by boiling of him in milk." It is almost self-evident, however, that the pickling of herring was carried on by the earliest settlers of America, and possibly by the fishermen who resorted to these shores from Europe before the country was settled, as it was an old-established business in Europe.

The quantity of herring preserved by the process of pickling is greater than that of all other species combined, aggregating nearly 3,000,000 barrels annually, but the yield in the United States (about 30,000 barrels annually) is small compared with the product of Scotland, Sweden, and the Netherlands. Half a century ago the output in New England was many times greater than at present, and there was a considerable export trade, amounting at times to 60,000 barrels; but, owing to carelessness in the method of pickling and absence of uniformity in the quality of the product and in weight of the packages, the trade has been captured by the foreign curers, who now sell about 150,000 barrels annually in the United States, at double the price received for the domestic article. In view of the large quantities of herring on the New England coast and the extensive markets that already exist in this country as well as in the adjacent countries to the south, it seems extremely desirable that more care should be given to the curing of this fish, and the preparation should be governed by fixed standards applicable to both quality and quantity.

The quality of pickled herring varies greatly, depending almost entirely on the quality of the fresh fish and the promptness and care exercised in curing them. Few fish are more difficult to properly cure than this species; the flesh is very delicate and tender, and not only does it injure readily, but it is much less able to take the salt if the pickling be long delayed after removal from the water. If placed in pickle before they have been much exposed, they take the salt quickly and the natural quality and flavor of the fish are better preserved. Another important rule in preparing this as well as other kinds of fish is to have the greatest possible cleanliness in the salting-houses and in the tubs and barrels used for salting.

There is no uniform method of curing herring in this country, but most of them are salted just as removed from the water, without splitting or dressing, and are known as "round herring," to distinguish them from the "gibbed herring," which have the gills, heart, etc., removed, and the "split herring," which have the gills and all viscera removed. The method of preparing each will be described separately.

ROUND HERRING.

The bulk of the herring salted on the New England coast are taken in the vessel gill-net fishery, and the fish are usually salted on board the vessels. Some are taken also by small boats making daily trips to the fishing-grounds, and these are necessarily salted on shore. The methods of salting the fish on the vessels and on shore differ only according to the facilities for handling them.

In the vessel fishery, as the herring are removed from the nets they are placed on deck and water is soused over to remove loose scales, blood, etc., and sometimes salt is sprinkled over them. They are next placed in hogshead tubs with about 3 pecks of salt to the barrel of fish scattered among them, when they are covered with brine and left standing for four or five days, or until they are struck. It is important that the salting be done as soon as practicable after the fish are removed from the water, and in the meantime they should be protected from the sun. After being struck, the fish are repacked in market barrels, where they remain for twenty-four hours for settling, when the barrels are topped up by adding a few struck fish to each barrel. It requires about 330 salted fish to fill a barrel, the number of fresh herring required being about 300. In packing the fish in the barrel, they are usually placed with backs slanting upward. Occasionally, however, those in the lower half of the barrel are placed back down, and sometimes a few upper and lower layers are carefully placed and the middle portions arranged with less care. After the barrel has been topped up it is filled with brine, headed, and stored in the hold. On arrival at port, if it appears from sounding that some of the pickle has leaked out, more is added through a hole bored in the bilge and the hole plugged up, when the barrel is ready for branding and marketing. Sometimes at the port the fish are repacked, so as to insure full weight and good fish, new brine being made, if necessary, but if the old pickle is clear it is used over again.

To determine the proper amount of salt required for curing herring requires considerable skill and experience, and the quantity varies according to the condition of the fish, the season of the year, etc. If too much salt be used the fish will soon become hard and dry, with greatly diminished flavor, but if the quantity of salt be insufficient the fish will become tainted and unfit for food within a short time. During warm weather more salt must be used than when the temperature is low, and thin small herring require less salt than thick or large ones. As a general rule, about 5 pecks of salt are required for curing each barrel of herring.

In pickling on shore, the fish on their arrival are dumped into tanks or wash barrels of sea water, from which they are at once removed with a brail net, the fish being rinsed up and down at the same time, and placed in a pickling butt or vat with about 3 pecks of salt scattered among each 200 pounds of fish and a heap placed on top. In two or three days a workman with high rubber boots passes over the butts, treading on the heaps of fish to separate them if massed together. Or, in some localities, the masses are separated by stirring them with a spudger, consisting of a thick board 10 inches long and 2 or 3 inches wide, nailed in the center to a wooden handle. The fish remain in the butts eight or ten days, being examined occasionally and more salt being added to keep the pickle sweet. After being thoroughly struck, the fish are removed with dip nets and placed on a packing table, whence they are packed in the market barrels, 200 pounds to each barrel, sometimes with backs up and sometimes with bellies up, according to market demands, about half a bushel of salt being scattered among them during the process of packing. The barrels are then

headed and a hole bored in the bilge or head and sufficient strong brine added to fill the barrel; the hole is then plugged and the barrel is ready for shipment. It is important that the herring be packed so tight in the barrel that their relative positions are not disturbed in handling the barrel, thus removing the scales and breaking the fish. There is little decrease in weight in pickling herring, 211 pounds of fresh fish making a barrel of 200 pounds of round herring. The market price for round herring during recent years has ranged from $3 to $5 per barrel.

The cost of preparing a barrel of pickled round herring in New England is about $2.37, apportioned as follows:

Cost of 200 pounds of fresh herring	$1.00
Labor of pickling in butts	.07
Salt used in pickling in butts	.20
Barrel	.50
Salt used in packing in barrel	.09
Labor of packing in barrel	.08
Cooperage	.06
Cartage	.07
Wear and tear, loss, etc	.30

GIBBED AND SPLIT HERRING.

Although most of the herring taken on the New England coast are salted round, some of them are either gibbed or split before being salted. This method of curing the fish is much more effective than salting them round, the latter being objectionable because all the blood is thereby retained in the fish and undergoes a slight decomposition before the salt thoroughly strikes through the skin and flesh. It is very infrequent that herring are salted round in Europe, the usual practice being to gib them before salting. Less salt is also required for preserving the fish when they have been gibbed, and thus the flavor of the product is improved. Gibbing consists in removing the gills, heart, and sometimes the viscera from the fish by means of the thumb and forefinger. It requires 228 pounds of round fish to make 200 pounds of gibbed fish. Gibbing is very little practiced now in the New England States, because the fish are usually not very fat, and look thin and poor when gibbed. Splitting is performed by cutting the fish down the belly to the vent, removing the gills and viscera, and usually the roe bags and milt of spawning herring. In some localities, especially at Eastport, Me., it is customary to immerse the fish in brine for a few moments before they are cut. This causes the herring to keep their scales better and brighter, and they can also be handled more readily in splitting. Splitting was originally applied only to the extra large herring in order to permit the salt to more readily strike through them; it is now commonly practiced in Newfoundland and Canada, but herring for pickling are rarely split down the belly in the extensive fisheries of Europe.

After evisceration the fish are immersed in tubs of salt water for a couple of hours to allow the blood to be soaked from them, when they are packed in butts or tight barrels, back down, with the stomach cavities filled with salt and with a layer of salt sprinkled between the layers of fish, about 3 pecks of salt being used for each barrel of fish. When properly struck the fish are repacked in the same manner as the round herring above described. In packing in the barrel some fishermen place them on their backs and slightly inclined to one side. Others place them fully on the back. The latter appears to be the better method, as it gives the herring a more round and thick appearance and the pickle has a better chance at the abdominal cavity. The split herring usually sell at about $1 per barrel more than round herring,

but in 1898 the price was approximately the same. A 200-pound barrel of fresh herring will weigh 144 pounds when split and eviscerated, losing 56 pounds in dressing. Sometimes, in order to fill out a shipment of split herring, round salted herring are split and eviscerated and added thereto. In this operation care must be taken not to tear the fish.

The present condition of the pickled-herring industry in this country is far from satisfactory. Great improvements in the methods of cure are desirable, and unless the quality of the product be bettered there seems little probability of an increase in the prosperity of the business. The abundance of these fish on the New England coast during certain seasons of the year, and the large market demand for pickled herring in this country, should encourage our fishermen to put up a product that will compare favorably and compete with the foreign-cured herring, the great necessity being a fixed standard, applicable to quantity as well as quality, with proper culling and grading of the different kinds. Usually during September and October there is a run of fine herring on the New England coast, which if prepared with that care exercised in the curing of European herring would probably be nearly if not equally as good; but at present their value is depreciated by too long exposure to the sun and air before salting, by carelessness in the manner of salting, failure to separate the fish into the various grades, and by using weak barrels in the packing.

THE IMPORTATION OF FOREIGN HERRING.

The great bulk of the pickled herring consumed in the United States is prepared in the Netherlands, Norway, and Scotland. Of the 1,321,020 barrels received during the ten years ending June 30, 1898, 377,480 barrels came from the Netherlands, 231,098 barrels from Norway and Sweden, and 111,198 barrels from Scotland.

The Holland herring are the most popular of those received in the United States, and the demand for them is constantly increasing. The first of the Holland herring arrive here in June. These are known as "matties," having small roe or milt. The "vol" herring, which have the roes fully developed, arrive usually about the latter part of July. The trade becomes brisk toward the end of August and continues until near the end of November. There is also considerable demand during February, March, and April, and usually all are sold before the 1st of June. The great bulk of the receipts, probably four-fifths, are in small kegs, containing from 45 to 55 herring, about 15½ pounds of fish. These kegs are made of hard wood and measure 9½ inches in height on the outside, 7¾ inches at the bilge inside, and 7 inches at the ends inside, with staves and bottoms ¼ inch in thickness. At the top of the keg the staves are slanted off at the ends, but at the bottom they are of the same thickness out to the ends. They are bound with 6, 8, 14, or 16 hoops, but more frequently with 6 or 8. When only 6 hoops are used the two end ones are usually of galvanized iron and the others of willow or similar material. On the head of the keg is branded the description of the contents, with some distinctive trade-mark.

In addition to the kegs, many Holland herring are received in barrels, containing from 242 to 254 pounds of fish, exclusive of the pickle. A few half-barrels and quarter-barrels are also received, but they do not take so well as the barrels and the sixteenths.

The price ranges from 45 to 75 cents per keg and $7 to $11 per barrel. Packages containing "milkers," or milt herring only, usually sell for 10 to 15 cents more per keg and from $1 to $2 more per barrel than those containing mixed herring.

The imports of Scotch herring have increased considerably during recent years, from 186 barrels in 1885 to 32,036 in 1898, most of which are received at the port of New York. A few years ago they usually sold for somewhat less than the Holland herring, but during the past two or three years they have sold for $2 to $4 more per barrel. These are also packed in small kegs, but the keg trade is not so extensive as in case of the Holland herring. The consumption of Norwegian herring is also increasing. Practically all the Norwegian and Scotch herring are sold in barrels, the former containing 400 to 800 fish or 221 pounds, and the latter from 350 to 700 fish or 250 pounds, exclusive of the pickle. The demand for these is greatest from September to November and from February to April.

Nearly all the receipts are on consignment, the consignee forwarding the account and remittance as soon as the herring are sold, receiving 5 per cent commission therefor. The expense of handling foreign herring at New York City approximates $2.45 per barrel, made up as follows: Duty (at ½ cent per pound), $1.25; brokerage, 25 cents; cartage, 20 cents; clearance, cooperage, storage, insurance, etc., 30 cents, and commission, at 5 per cent, 45 cents. The following summary shows the ruling prices during October, 1898, for the various classes of foreign herring in the New York market:

Description.	Number to barrel.	Number to keg.	Half-barrels, price.	Barrels, price.
Holland herring:				
Full white hoops, mixed		52 to 54	$4.00 to $4.50	$7.25 to $7.50
Full white hoops, milkers		62 to 65	4.75 to 5.00	8.25 to 8.50
Scotch herring:				
Large fulls, E. C	550 to 675		5.00 to 5.25	9.00 to 9.50
Fulls, E. C	650 to 750		4.75 to 5.00	9.00
Large fulls, W. C	500 to 550		4.50 to 5.00	9.00 to 9.50
Mediums, W. C	300 to 350			8.25 to 8.50
Norwegian herring:				
K. K. K. K	425 to 475			10.50
K. K. K	550 to 600			8.50
K. K	700 to 800			10.00
K	800 to 900			9.50
Cutheads				7.00
Belly cuts				6.00
Bristling				6.00

FOREIGN METHODS OF CURING HERRING.

The importance of improvement in our methods of pickling herring is sufficient reason for introducing in this connection some notes on the methods of curing herring in foreign countries. Mr. Adolph Nielsen, who has had considerable experience with the various methods in use, furnishes the following accounts of the processes of pickling herring in Scotland, Norway, and the Netherlands:

THE SCOTCH CURE OF HERRING.

As soon as the herring is landed and sprinkled with salt the gibbing and cutting take place. This is performed in the following manner: The herring is held in the left hand, stomach up, in such way that the head reaches beyond the thumb and forefinger (index). With the other hand a small straight-edged and sharp-pointed knife is pushed in just below the gill lid on that side of the herring that shows toward the right hand and forced right through the throat, close to the neck bone, so that the point of the knife comes well out on the other side. The forefinger is then pressed against the head and the thumb across the pectoral fins. A little cut with the knife is first made down in the direction of the tail, after which it is given a twist and a cut made close up under the pectoral fins. The throat is grasped between the index and middle finger (on the right hand), with a smart jerk, the intestinals (stomach, crown gut, liver, and heart), along with the gills and pectoral fins, are torn out, leaving only the milt or roe to remain in the herring. When the herring is intended for export to Continental markets the crown gut is often allowed to remain.

Another way of gutting herring, when these formerly have been clipped, is to put the thumb

behind the gills and with a jerk from the top and downwards break the gills loose from the head; when these are then taken out the œsophagus (gullet) and the stomach follow, because all these are cohesive; but this way is seldom in use anywhere else than in some cases in Norway.

According as the herring are gibbed and gutted they are sorted in baskets and put into the sousing tubs, where they are rolled in small Liverpool salt before being packed in barrels, generally made of birch. In these the herring are packed fully on their backs, with a small plateful of salt sprinkled over each layer of fish. The one layer of herring is put across the other the whole barrel through, and each layer furnished with two "head-herrings," put on their sides. The barrels are filled until a couple layers of fish extend above the chime or top, and covered with wooden covers made for that purpose. In this way they remain two or three days, after which time, when the herring has settled, the barrels are filled up again with fish from the same packing, headed up, and put down on their sides. Every second day, as a rule, the barrels are given a little turn around until the last packing (bung packing) takes place. A lookout is during this time kept upon the barrels, that none of them are leaking. In order to obtain the official crown brand the herring must have been in salt at least ten days, exclusive of the first-day packing. When the barrels, after such time or later on, are going to be made ready for shipment, the pickle is drawn off through the bungholes and these plugged up; the barrels are then opened and more herring of the same packing pressed into the barrels, either by means of a common press or by pressing the herrings down either by hand or by trampling them down after a small barrel head has been placed on top of the herring. Care is in the meantime taken that the herring is not pressed so tight that no room is left for the pickle. The object with this last and tight packing is to prevent the herring from being shaken about in the barrels during the time of conveyance and to save the recipient from the trouble of repacking the barrels after they have reached their place of destination. After a sufficient quantity of herring is pressed into the barrels, they are headed up and filled through the bunghole with the same pickle that was drawn off formerly, after being strained. The bungs are then put in tight, the hoops driven home, and the barrels blown; after they are joined tight the uppermost hoop is nailed fast, the blowhole stopped up, and they are in a condition ready for shipment. If the herring is to be exported to countries outside the European Continent or to hot climates, it is generally, when the bung packing takes place, emptied out of the barrels altogether; the crown gut is removed if it has been left, and the herring rinsed in clean water and repacked with coarse Liverpool salt. In place of using the original pickle, the barrels are then filled with new pickle made of clean salt. All these barrels are full-banded and furnished with a 1-inch-wide iron hoop on each end. In order to obtain the official crown brand, such barrels should contain no less than 212 pounds of herring, exclusive of salt and pickle. A good many of the Scotch herring are also packed in half-barrels.

The system of culling, along with the official crown mark on all exported herring barrels, has contributed more to the good reputation the Scotch herrings have gained in the continental markets than many may imagine. The dealers, on reception of Scotch herring with the crown brand, are satisfied that the barrels really contain what they are branded for in regard to quality and weight, and this has given them such confidence in the Scotch herring that these are received and approved of without even being opened, while the Norwegian herring barrels, since the official branding was abolished in 1851, must be opened and repacked before the recipient can sell them, which often causes a good deal of inconvenience. The Scotch herring are sorted and branded according to the treatment or cure and the development of the sexual organs.

Crown P, Full Brand: Barrels obtaining this brand must contain all fine, well-cured, large, full herring, and not mixed with herring of a poorer quality, nor with spent herring, nor matties, which have not got their roe or milt fully developed.

Crown P, Matties Brand: Barrels with this brand must contain fine, rich herring, with small milt or roe, must be well cured, and not mixed with full, spent, broken, or dismembered herring.

Crown P, Spent Brand: Barrels with this brand should contain spent herring (herring with their sexual organs more or less collapsed after spawning), properly gibbed and cured, and all full herring, matties, broken or dismembered herring sorted out.

Crown P, Mixed Brand: This brand is used for mixed herring (such herring as can not be sorted as full, matties or spent). The mixed herring should also be properly gibbed, packed, and cured, and no dismembered herring be packed in the barrels.

Crown PP, Repacked Brand: Barrels with this brand should contain herring which have been in salt at least ten days, exclusive of the day of packing and the day of repacking and branding. Further, this herring should, when they are repacked, be emptied out of the barrels in which they were first packed or cured, the crown gut be removed, and the herring be rinsed and repacked,

with sufficient salt, in the same barrels, and supplied with new, strong pickle made of clean salt. The barrels should be full-branded and furnished with a 1-inch wide iron hoop on each end.

Lozenge Brand: This brand is used for herring which formerly have been bung-packed and branded but afterwards repacked in the same way as is required in order to obtain the repacked brand. The lozenge is branded just below the crown brand. In case new barrels are employed, they are branded with the crown brand and the lozenge in the same way.

THE DUTCH CURE OF HERRING.

The most of the Dutch herring are caught at sea in drift-nets and cured on board of the vessels. If there is a chance, the dressing (gibbing and cutting) takes place according as the nets are hauled on board and the herring picked out of them. The Dutch way of gibbing and cutting herring is about the same as the Scotch; the only difference is that the crown gut is allowed to remain in the herring, and it is considered that the fat which is attached to this gives the herring a nice flavor. After the knife is put through the throat the cut is at once made up toward the pectoral fins; thus the opening is made smaller than in the Scotch herring.

According as the herrings are dressed they are sorted in baskets, and from these about 200 at a time are put into large trays filled with fine Lisbon or St. Ybes salt and rolled in this salt. After the herring is carefully and well rolled in the salt it is packed in barrels, back down, the same way as the Scotch, with Lisbon salt sprinkled on the top of each layer of fish. When the whole catch is salted down a bucket of *blood-pickle* (made of sea-water and the intestines from the dressing) is put over the herring, and the barrels headed and put down in the vessel's hold.

The object of heading up the barrels so soon is to prevent the herring from being affected by the air. In this state the barrels remain for from six to ten days, when they are taken up and filled with herring of the same packing, after the pickle is first drawn. This filling or sea-packing is pretty compact, and it takes about four barrels to fill three of them. After the barrels are filled, the original pickle, after being strained, is put over the herring, and the barrels headed up and blown, and if found tight, put back into the hold of the vessel. It is considered of importance not to undertake the filling of the barrels too early, as the herring in such cases will be shriveled; but, on the other hand, it should not be performed too late, because if so the herrings, by being tossed about in the pickle while the vessel is rolling in the sea, lose a great deal of their scales. After the vessels arrive home, the barrels are again filled with herring and supplied with the original pickle. In this last filling, it is generally estimated that thirteen barrels of herring in a fit state for shipment are obtained from fourteen sea-packed barrels. A large quantity of herring is also repacked in small kegs—one-sixteenth part of a barrel—and containing from 45 to 50 herrings. This is especially for the American markets. A smaller quantity is also packed in half-barrels, but these do not take very well. A Dutch barrel of full, selected herring, with milt and roe, contains about 800 herrings, which weigh from 110 to 115 kilograms (242.2 to 254.6 pounds) net, exclusive of salt and pickle.

Dutch herrings are sorted, according to the development of the sexual organs, in four qualities: Full herring (vol herring, branded VOL); matties (maatjis, branded M); spent herring (Ijlen, branded IJ or IJLE), and herring which have recently spawned (Ruit, branded KZ). Besides, herrings which have not been packed before the day after they were caught are branded O. Each of the first three brands are again sorted in three or more qualities, and branded No. 1, 2, and 3. All herring which on account of so large a catch could not be cured the same day, but had to be left over a night before they were packed, together with torn bellies, or chafed herring, are assorted according to quality, as No. 3, while all herring in good condition and free from faults, as No. 1 and No. 2, according to quality and treatment. Distinction is also made between herring caught in the open sea, near the coast, and in the Zuider Sea; and the barrels are generally furnished with a mark signifying the place and the year in which the herrings were caught. Before the official system of culling was abolished, in the year 1878, this was branded on the bilge of the barrels (or if the herring were packed in smaller packages on the most convenient place) by the culler in such manner that a royal crown was branded in the middle, and the other directions in letters on either side of the crown.

THE NORWEGIAN CURE OF HERRING.

The largest quantity of herring in Norway is caught in the fjords by seines, and kept barred until what food the herring may contain is worked out in the natural way before they are taken up, dressed, and salted. As a rule the herring are salted in the vicinity of the places where they are caught, so that they can be put in salt almost alive, which is of the utmost importance in order to obtain a good article. In this way they have an advantage over the Scotch, who have to go far

off the coast for their herring and can not get them in salt before they reach the shore, which often takes a long time. They have an advantage over the Dutch, because, although they salt their herring on board of their vessels soon after they are caught, still they may have been dead several hours in the nets before they are hauled on board, and at all events none of the herring taken in drift-nets or other nets can be deprived fully of the injurious food they may contain, as they can when barred in a seine. When brought to the shore or salting places from the seiue the herrings are gibbed in this way: That a triangular piece of the throat, large enough to admit the heart and the pectoral fins to be removed, is cut out by means of scissors made for that purpose, or by a small knife (some also use the fingers). This cut should be made deep enough to divide the large blood veins, situated close to the neck bone, in order to remove the blood they contain. Sometimes, also, the gills are removed, especially on the full herring caught in the spring.

Generally a large enough crew is employed to admit the gibbing and the salting to take place at the one time. On account of the herring caught in seines being always mixed, every gibber has got placed before him or her so mauy barrels or tubs as the herring are to be sorted in (from three to five); and, according as they are gibbed, every herring is also at the same time, by the gibber, sorted and placed in the various barrels or tubs to which they belong. The salter then takes the herring and packs them in new barrels, which lately have been soaked in sea water, slantwise on their back, with one-fourth barrel of St. Ybes salt to 1 barrel of herring. The herring are packed loosely, one lies across the other the whole barrel through. The uppermost layers are packed sometimes slantwise back up. Some packers put from 1½ to 2 gallons of pickle (made of one-fourth barrel of salt to 1 barrel of sea water) on the herring soon after it is salted, and head up the barrels immediately. Others, again, let the barrels remain unheaded for one day before they fill them with pickle. Before the barrels are headed up a layer or two of herring are generally put into the barrels in order to fill up the empty room caused by the shrinking of the herrings. By putting the pickle on the herring soon after they are packed the salt dissolves quicker and saturates the herring more speedily, so that the contents of the stomach (provided the food is liberated) hardly has any injurious effects upon the durability of the herring. After the barrels are headed up they are broached in the head and blown into by means of a brass pipe containing a valve, which is put down in the hole, and, if found tight, the hole is plugged up as soon as the air has escaped; if not, they are made tight in the places where they are leaky, and blown over again before they are stowed down on board the vessels.

After reaching the port of shipment and before beiug exported the herring are repacked aud the barrels filled with the original pickle which was formed first; and if this does not hold out, new pickle is made to supply what is wanting. As a rule the herring are repacked in such a way that out of 4 barrels salted in the fishing-places from 3¼ to 3½ barrels of herring are obtained when packed for shipment. They never, as a rule, pack their herring as light as the Scotch or Dutch do, except the herring is specially to be put up in such style.

The followiug notes on pickling herring are from Nielsen's Report on the Cure of Herring:

Qualities of the good herring.—Concerning the nature of the fresh herring, it is required, in order to obtain a good article, that the herring also possess certain qualifications, such as sufficient size and maturity, fleshiness, aud fatuess. A lean, dry, dismembered or half-rotten herriug can never give a good article, even if it is cured ever so well. A small herring, which has not reached the full state of maturity, fetches only small prices in the markets. Of much importance is also the development of the sexual organs. If these are in a far advanced state, the herriug loses in fatness and flavor. These should be firm and the whole flesh penetrated with a certain qnantity of fat. Large amounts of fat around the blind-gut is a sign of the herring being fat right through the flesh. As a rule, oceau herring (such herring as pass most of the time in the ocean, and only approach the coast for reproductive purposes) are considered superior to the herring that keep themselves close to the coast or in the bays all the time. Of these herring, again, those which are caught in deep water are better than those caught in shoal water. A first-class herring is known by its small head, short and plump body; is broad across the back, and plump toward the tail, and has got a great depth from the back to the abdomen, which gives this well-rounded shape.

Importance of early salting.—In order to obtain a good article of salt-cured herring it is necessary that the herring be liberated from its food and put in salt as soon as possible after being brought out from the water. Eveu if the quality is ever so fine, a good article can never be had if it is not properly treated during the whole cure. The Scotch herriug can not get the official crown brand

except they are salted at least twenty-four hours after being brought out from the sea. As a rule the curers do not care about herring which is more than twenty-four hours out of the sea before they are landed, and only take those at a low figure. In Holland, even, a distinction is made between herring which are taken out first and those which are taken last from the nets. The cure of herring on board the fishing crafts commences, therefore, if circumstances allow, soon after the nets are hauled in. To leave the herring exposed to the hot sun while being conveyed to the salting-place, or to leave the herring in the nets until the shore is reached, if the catch has taken place a long distance off the shore, is objectionable. An old law in Norway, of 1775, even prohibited people from taking such herring from their seines in the summer time before 10 o'clock in the evening and after 5 o'clock in the morning, if it was going to be salted for export.

Best salt for herring.—In regard to what kind of salt is the most suitable for salting herring, it is difficult to give any one sort the preference. The choice of salt depends much upon how the herring is going to be cured, and upon the size and quality. The main thing is that the salt is clean, and that it is used in proper quantities. Fine and watery salt melts quicker, but gives weaker pickle. In cases where it is of importance to form pickle speedily, fine salt is preferable, while coarse salt is better for use in filling and repacking, or when the herring is intended for export to hot climate, or to be kept in stock for any length of time. The Scotch curers use Liverpool salt, the Dutch light Cadiz or Lisbon salt, while the Norwegians use St. Ybes salt. It is of much importance, as formerly stated, to put the herring in salt as quick as possible, if a first-class article shall be obtained. For this reason the Scotch, as the herring is landed, sprinkle it heavily with salt in bins or vessels made for that purpose, before it is gibbed and gutted. Generally they use 1 barrel of Lisbon or coarse Liverpool salt (or sometimes both mixed) to about 10 barrels of herring. By this means the herring keep their scales better and brighter, and can also be handled better and quicker when they are afterwards gibbed and gutted. The Hollanders roll their herrings in trays filled with fine Liverpool or St. Ybes salt as soon as they are gibbed and gutted, before they pack them in barrels; and this work is done very precisely. In Norway no sprinkling with salt, as a rule, is used before the herrings are gibbed or packed in barrels, but instead thereof they have to use more salt in packing than the Scotch and Dutch. The sprinkling of herring with salt as soon as they are landed or brought on board of the vessels is considered also to improve the flavor of them very much.

Packing herring.—In packing the herring in barrels it is recommendable not to pack them too tight before they have shrunk in the salt, and also to pack herring of the same size and quality right through the whole barrel. The packing is performed differently among different nations. In Norway the herrings are packed slantwise on their back, while the Scotch and Hollanders pack them fully on their back. By this last mode (which no doubt is the best) the herring get a more round and thick appearance in the pack; and it has also this advantage, that the pickle has got a better chance to get in and saturate through the abdominal cavity of the gutted herring. After the herring has shrunk in the salt the barrels are filled up again and put away, but care is taken that the herring is not packed too hard. As long as the barrels are left to remain still there is no need of hard packing, but when they are to be shipped it is recommendable to repack the herring so tight that they do not move about, even if the barrels are handled ever so roughly, so that the receiver may be exempted from filling the barrels again after they have reached their place of destination.

Herring barrels.—The quality of barrels used for salting herring in is of much importance in order to obtain a desirable product. If too soft wood is employed, the pickle will work through the staves, the herring become dry, and be damaged within a short time. Among the foliferous wood in Europe the populus (poplar) is considered least answerable, and among the conifers the spruce or fir are less suitable than the red pine wood, because the former is generally knotty and more ready to get saturated with pickle or water. Good hard and clean spruce, which is cut fresh and has not been soaked in water, may compete with the pine when it gets properly seasoned. The Hollanders use mostly barrels made of oak; the Scotch use barrels of birch or beech, and the Norwegians use barrels of spruce and red pine wood. Staves made of birch are brittle and apt to twist. In Scotland the regulations for making herring barrels are that the staves shall be not less than half an inch thick and not wider than 6 inches, except the oak staves, which may be 7 inches wide, and that the bottoms should be at least of the same thickness as the staves, and none of the pieces of which it consists be made wider than 8 inches. The usual thickness of the staves in the Scotch herring barrels are from nine-sixteenths to ten-sixteenths of an inch, and the bottoms are generally made three-fourths of an inch thick. In Holland there was a law passed enacting that a herring barrel should be manufactured of at least 13 staves (which makes every stave on an average 5½ inch wide), and that no stave should be

less than three-eighths of an inch in thickness. In Norway the staves, as a rule, are made five-eighths inch thick, and the barrels are mostly made by machinery. Scotch barrels are generally full banded for export to hot climates in the summer time. They are also furnished with an iron hoop on each end. The Dutch barrels are furnished with 18 to 20 hoops, divided 5 or 6 on each end and 4 on each side of the middle, while the Norwegians have only 12 to 16, divided 3 and 3 or 4 and 4.

In Norway a movement has been made lately to get a law according to which all barrels for shipment of herring should be manufactured of a certain kind of wood and of certain dimensions, but, so far as I am aware, such act has not been passed yet. If the barrels are made of fat spruce or red pine, and also of oak, the herring will take a flavor from the barrels, which some people like very much, but others, again, do not care for. In Scotland it was prohibited to salt herring in barrels manufactured of red pine until the year 1874, and for many years back a similar act or law existed in Norway; but this law was repealed again on account of the Russians, who consumed large quantities of salted herring, and valued the Norway cure very much on account of the resinous taste the herring got from the red pine barrels. Some people, again, value the Dutch herring very much on account of the taste or flavor they receive from the barrels. To keep the barrels from shrinking, it is recommended to put a little pickle in them while they are kept in stock.

In 1889 the government of the Dominion of Canada appointed delegates to visit Scotland and the Netherlands for the purpose of studying their methods of curing herring. After making a careful investigation they summed up their conclusions in part as follows:

We consider the Scotch system of treating herring, as an article of commerce, to be as perfect as any system can be when honestly carried out in all its integrity, and that improvements in the herring industry of Canada can safely be made after the Scotch model, so far as our somewhat different circumstances may permit. In one most important respect the Scotch fishermen have an immense advantage over the Canadian fisherman, and that is in having all the curing and packing of herrings performed by a distinct and independent class of merchants known as fish-curers. We have seen that the herring industry of Scotland never amounted to anything—never prospered—until an enterprising and energetic body of men came forward and assumed the position of fish-curers, taking that part of the business entirely out of the hands of the fishermen, to the great relief of the latter, and the promotion of this important business. In order, therefore, to place this industry in Canada upon a satisfactory and permanent basis we are of opinion—

(1) That while some slight degree of improvement in the details of curing and packing herrings may be at once attained by changes in the present methods, yet no real permanent improvement can take place, nor can the herring industry in Canada be placed upon a satisfactory commercial basis until the fisherman ceases to be his own fish-curer, and until the business of curing is taken in hand by a class of merchant fish-curers, as in Scotland—men of energy, business experience, and capital, with all the necessary appliances to carry on the business on fixed principles and in accordance with such regulations as may be promulgated for the benefit of the trade from time to time. In Scotland nearly all the curers devote their whole time to the supervision of their own curing operations. In former times if a fish-curer did not so superintend his own curing business he made arrangements with a master cooper to furnish the barrels, and generally to superintend the cure and putting up, guaranteeing that the same would pass the Crown brand; or he hired journeymen coopers and a foreman, laid in materials for the manufacture of barrels, and the foreman attended to the curing for the market. This was the method to a great extent in Scotland 55 years ago, and to some extent still.

When a fisherman cures his own fish, it is done with the least possible labor and cost, and once they pass into the hands of the merchant or trader, paying up so much of his indebtedness to the former, he feels no more interest in the matter. But it is different with the merchant or curer; his capital, his credit, and his good name are at stake, and unless his fish are properly cured he will be the loser. Thus the strongest of all motives, self-interest, would induce him to cure and put up for market an article calculated to render a return for his outlay.

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(3) *The barrel.*—That the present Canadian barrel, being too weak to stand the rough handling to which it is exposed on the railways in transportation, should be greatly improved. We think the present capacity of the barrel should be retained; that it should contain not less than 200 pounds of

herrings, exclusive of salt; that it should be made of stronger material; that the staves should be of hard wood wherever possible, and that if spruce is permitted to be used, the staves should be thicker and stronger than the present stave. Fir and pine should be prohibited. The rule in Scotland has been that the barrel might be made of any kind of wood, fir excepted. It seems very probable that a fir or pine barrel may "sour" fish or other animal food packed in it for the first time. If a new pine barrel or cask be filled full of pure water and covered up and allowed to stand for some weeks there will be formed in the water a pretty firm gelatinous substance, which, if allowed to remain for some time, becomes very offensive, as has been the case often in regard to pipes made of tamarac and pine used for conveying water underground, where frequently pipes with a 3-inch bore have been nearly clogged up from end to end with this offensive matter. If cleaned out, however, and the pipes relaid, the gelatinous substance will not again form.

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It is universally conceded that oak barrels are the best of all, and, where procurable, the Dutch use no other kind. The present barrel we think, after sufficient notice, should be prohibited. We are of opinion that a little more bilge would add to the strength of the barrel. The hoops should be of better quality than they are now and there should be more of them; and all barrels intended for transportation beyond the province where the fish are put up should have at least one iron hoop at the top; and should the barrel be of spruce or Norway larch, then, in addition to a thicker stave, there should be an iron hoop at each end. If, however, hard-wood staves can be procured in sufficient quantity, we think that soft-wood barrels should not be allowed. The knot of the hoop should be longer than it is in the case of the present hoop, to prevent it suddenly springing off. There should be in the side of the barrel, above the bottom hoops, 15 or 16 inches from bottom, a bunghole about 1 inch in diameter, with well-fitting bung, and the usual rule as to crossing the heads should be observed. The new standard barrel, when decided upon, should be made a legal standard by act of Parliament, as is intended to be done in Britain at the next session of the Imperial Parliament. There should also be a legalized half-barrel built of the same material and in proportion to the size of material used in the large barrels.

(4) *Small packages.*—We are of opinion that in addition to the barrel and half-barrel, there should be established a grade of small packages in which to put up repacked herrings, after the manner of the Dutch and Germans; that these packages or kegs should be integral parts of the large barrels, say one-fourth, one-eighth, and one-tenth parts of the full-sized barrels. We believe that kegs in every way suitable for this purpose may be procured in Canada. A gentleman largely interested in the sugar-refining business told us that he gets a very neat, small keg or kit, for holding sirup, made in Ontario, at reasonable prices, and he considers that the small herring keg can be made here as well and nearly as cheaply as in Holland. If so, then a very great step is assured toward the establishment of what we believe to be a most important and profitable branch of the herring industry of the Dominion.

We are of opinion that the very first movement toward improvement in this industry should be in the direction of improving the herring barrel and consequent discouragement to the manufacture of the present barrel.

As already stated, there can be no doubt that a very large business can be done in the small package line, if properly gone into and taken hold of with energy and in a business manner. Canada should be able to largely supply the demand on this Continent for herring put up in this way.

(5) *Curing.*—That next in importance to the catching of the herring is the proper curing of them. This process commences in having the salt brought into contact with the herring as soon as caught; and if it could be done at sea as soon as the herring come out of the water, so much the better and so much more thorough the cure. All the printed evidence, all the experience of the Dutch, the Yarmouth fishermen, and others, and all that we heard on the subject goes to confirm this. If attention to this preliminary salting be necessary, and so salutary in results in Britain, how much more necessary is it in the maritime provinces, where the temperature in summer is so much higher? In order, therefore, to preserve the herring from incipient taint and to retain all the delicate flavor and natural excellence of the fish, it is absolutely necessary that at the earliest possible moment the curing process shall commence, and that the herring be scrupulously shaded and sheltered from the damaging effects of the sun throughout all the stages of gutting, curing, packing, etc. This is most important because injury caused to the herring by exposure to the sun can never be remedied. The injury sustained by herring in this way is beyond the power of man to remedy. Inordinate quantities of salt, soaking and washing in water may cover up the damage done and prevent further taint, but the lost

excellence of the fish can never be restored. There can be no doubt that the great bulk of the injury sustained by the herring of the Maritime Provinces is caused in this way; and if this can be avoided in the future by the adoption of some feasible inexpensive measures to protect the herring from the sun, from the time of catch to the time of shipment, a great point will be gained and much done to redeem the character of the Canadian herrings. The next step in the curing process is the "roosing" of the herring after gutting and the proper salting of the fish when being packed. Should it happen that the preliminary salting can not be effected before delivery, then the herring should be well sprinkled with salt during delivery. The western consumer is about tired of eating herrings, out of which all excellence has been extracted by soaking in water and oversalting, and if these western markets are to be retained the quality of the fish must be improved, and that at once.

(6) *Gutting.*—That we consider the Scotch mode of gutting to be as good as any for all commercial purposes, and all that can be desired when properly carried out and the curing properly attended to. In Scotland the early herrings are very fat, and are not branded. These are the herrings which are in such request by the wealthy families of Russia, and they are hurried over to Stettin for immediate sale and use. A fish-curer told us that some of these herrings sold in June, 1889, for £10 sterling ($50) per barrel. There is no material difference in the mode of curing these herrings. In Canada, however, it appears that in the case of fat herrings caught in July and August special treatment has been found necessary. Mr. Gordon, of Pictou, who has had much experience in the herring business in Scotland and in Nova Scotia, says:

"I beg to advert to the only additional detail, which, in my experience, I have discovered as applicable to the perfect cure of herrings in the months of July and August, on the coasts of Nova Scotia. Having engaged on my own account in a sailing vessel trading on the coast of Nova Scotia and Cape Breton, and provided with salt and barrels, I preferred purchasing the herrings in their green state, and cured a few barrels after the Scotch manner. On examination of the fish after being struck, I discovered an incipient taint along the backbone of the fish, which would increase with age, so as to render them unsuitable for a distant market in a tropical climate. I came to the conclusion that the taint was owing to excess of temperature here over that common on the Scottish coasts, and besides the herrings are larger and fatter in the months of July and August on this coast than on the coast of Scotland. Thereafter I ripped with a sharp knife the belly of the fish, and filled the belly with salt, and immediately packed them in tight barrels, with one bushel of Liverpool salt to each barrel, and protected the barrels from sun and rain."

Another gentleman, referring to the same subject, says: "Herrings should be all opened with a knife and filled with salt; otherwise they can not be properly cured." This latter statement, as applying to all herrings, seems rather general. Mr. Gordon only recommends this treatment in the case of herrings caught in July and August on the coast of Nova Scotia, when the fish are very fat. Even then it can hardly be possible that the belly of every herring need be filled with salt. To fill a herring with salt must effectually destroy the flavor of the herring and leave it as innutritious as a piece of basswood. It may be, however, that some of these July and August herrings may be utilized for the manufacture of kippered herrings. In October, 1889, a very fine and well-flavored kipper, said to come from Baltimore, U. S., was for sale in Toronto at high prices. It was very fat. The "ciscoes" of Lake Ontario are very fat, fully one-fourth or one-third oil, yet they make most delicious kippers, are in great demand, and sell at high prices. The "ciscoe" is a herring and is taken in deep water in the fall of the year. Many of them are put up as bloaters.

All of this shows how necessary it is that some one or more competent men, experts, technically and practically, in all pertaining to the classification of herring, should fully investigate all the different kinds of herrings on our Atlantic coasts, and decide upon the different modes of cure adapted to special kinds of herrings in special localities and at special seasons of the year.

(7) *Round or ungutted herrings.*—That between the mode above recommended by Mr. Gordon and the mode of putting up round or ungutted herrings there must exist many degrees of difference. We have already referred to ungutted herring, and to the fact that the Scotch curers strongly disapprove of packing ungutted herring, and expressed their surprise that any people of the present day would waste salt and time for such a purpose. In the case of the best packed herrings, if a stave breaks and the brine runs off, the herrings undergo very serious deterioration, but in the case of ungutted herrings, under similar circumstances, total destruction of the contents of the barrel would take place from the setting free of the elements of decomposition contained in the ungutted herring theretofore held in check by the preservative qualities of the salt and pickle. Round or ungutted herrings put on the market in any quantity can only do harm by damaging the character of the whole catch of any given locality. We therefore consider the putting up of all such herring for commercial purposes should be strictly forbidden.

(17) *Washing of herring.*—As stated elsewhere, the washing of herring before curing is not practiced in Scotland, and so far as we can learn never has been. The Scotch curers with whom we conversed on the subject were surprised to hear of herring in Canada being washed before curing. They could hardly believe such a practice possible. To show what has been the practice in the Maritime Provinces in time past, we quote from the answer of Mr. Gordon, Pictou, to question No. 4, in 1869. He says:

"It is the universal practice of Nova Scotia fishermen to steep the fish for hours before salting down, and expose them to the action of the sun during the hottest period of the season until the water becomes warm, under the erroneous impression that they are thus benefited by the extraction of the blood. Under this treatment herring part with their scales and juice, and are deprived of that flavor peculiar to herring properly cured. Besides the body of the fish thus saturated with water is rendered tasteless, brittle, and short, and not calculated to turn out satisfactorily at the end of a long sea voyage. The Scotch curers take every precaution to keep the herring from contact with water before and after salting. Salt the fish in their blood and the salt will extract the blood."

Now, it must be quite clear to every man who realizes the importance of retaining intact all those qualities of substance and flavor which render the herring so valuable as a wholesome and pleasant article of food, and which are so highly prized in Europe as already stated, that there could be no more effectual mode devised or adopted for the total destruction of all those qualities than the mode above described by Mr. Gordon. What would be thought of any man or body of men who should treat any kind of animal flesh, beef or pork for instance, in such a manner, and what would be thought of any one who would subject those articles of food to such treatment? Who would think of selling or buying meat so treated? Then, to cover up the damage done by the water soaking to the herring, inordinate quantities of salt are used, and this extracts any vestige of flavor the water may have left, and destroys all the nutritive qualities of the herring.

Here we may be permitted to refer to another pernicious habit, already adverted to—the practice of putting brine on the newly packed herring, in addition to the salt in which they have been cured. This practice is highly objectionable, and is one also that effectually destroys the good qualities of the herring in flavor and substance. This practice may arise from the custom of putting herring down in large casks or vats, and then, after a time, repacking into the common tight herring barrel. Herring treated in this way can not be much better than those soaked for hours in warm water. The herring should be packed in tight herring barrels in the first instance, and fully salted, when the necessary quantity of pickle will be formed from the dissolution of the salt caused by the moisture in the fish. The addition of newly made pickle not only interferes with the curing process going on in the barrel, but, as already stated, as effectually destroys the natural qualities of the herring as soaking in water, or the action of the sun's rays acting through the medium of water. We therefore consider that the practice of washing and soaking herring in water and of adding newly made pickle to newly packed herring should be strictly prohibited.

Having already described the Scottish method of curing and packing herrings, and having expressed our opinion of that system as being entirely adapted to the curing of herrings on our Atlantic coasts, we feel convinced that its general adoption and its legal enforcement would, in a very short time, give Canadian herrings a very high standard and character in the markets in which they are now held in very low estimation. We have given this subject our best consideration, and so convinced are we of the vital importance of proper curing and protection from sun and rain, that we would again urge that every diligence and care be exercised in these respects, as well as to the quality, selection, and separation of the fish in the first instance. It is most desirable that the fish, especially during the hot season, should be handled and shifted as little as possible, as every time they are turned over they part with a portion of the scales and become softer and softer, more flabby, and less ready to absorb the salt.

In the matter of packing pickled herrings for the purpose of repacking into small packages, very great care should be taken to have the fish of the best quality in every respect. In Holland and Scotland, as we have shown, "fulls" and "crown fulls," the highest brands, are taken for this purpose. The repacking should be done well and neatly and the kegs, as already stated, filled up with the brine from the large barrel out of which the fish has been taken. A slight sprinkling of salt on the bottom of the keg and the top tier of the herring should be given.

This branch of the business is worthy of the special consideration and effort of all who may engage in the curing of herring. We know that in western Ontario there is now a demand for herring put up in small packages, especially in the rural districts. It can readily be seen that in a country where there is so much beef and pork not many families will purchase whole barrels of herrings, while many would gladly purchase herrings in half-barrels, quarter-barrels, and the smaller packages.

If the Dutch and Germans can afford to pay freight and shipping charges on herrings from Scotland to Holland and Germany, unpack and repack into small packages, pay freight and shipping charges to New York, and sell these herrings in Quebec and Ontario, with a good margin of profit, surely the herring traders of the Maritime Provinces should be able to supply herrings in this shape as good in quality, at lower prices, and with a better margin of profit. By supplying a proper article this branch of the trade can be increased immeasurably both in the United States—the Western States especially—and in the inland provinces of the Dominion.

BRINE-SALTED ALEWIVES OR RIVER HERRING.

At various points along the Atlantic coast more or less alewives or river herring are brine-salted each year. They are prepared in greatest abundance in the tributaries of Chesapeake Bay and the coastal waters of North Carolina, where they are known only as herring, and also to a less extent in Maine and Massachusetts. At the head of Chesapeake Bay 30,000 barrels of herring are brine-salted annually, the number of fish required for the pack approximating 20,000,000. It is not unusual for 300 or 400 barrels of pickled herring to be prepared as the result of a single haul of a seine, and 900 barrels were salted from one haul in 1893. The Chesapeake product is used mostly in the South, and is distributed principally from Alexandria, Fredericksburg, and Richmond. The alewives salted in New England are sold also through the South to some extent, but many of them are sent to the West Indies and South American countries.

The methods of pickling river herring or alewives do not differ greatly from those applied to the sea herring on the New England coast, except that the market price being lower necessitates that they should be prepared in a cheaper manner. The flavor of the alewife does not equal that of the sea herring, consequently there is little need for the nice discrimination required in case of the latter. Usually more salt is used in preserving them than for sea herring, and as a result they will keep much longer. Mr. Joseph Farris, of Eastport, Me., states:

> The chief difference between the alewife and the herring in their capacity to keep for a long time is that the alewife has less flavor than the herring. It is almost without flavor. When the herring loses its flavor it becomes insipid and unpalatable, although it may be sound; but so long as the alewife is sound it is as suitable for food as at any time in its preserved condition. Alewives are sometimes kept on hand three years before being shipped, but if herring are not shipped within one year after being cured they are usually turned out of the barrels and used for fertilizer.

The three principal classes of pickled alewives are, (1) "gross," the entire fish being salted, corresponding to the round herring of the New England coast; (2) "split" or "cut," the head and viscera having been removed before salting; (3) "roes," the head being removed and the main gut drawn, but with the roe left in the fish. Each locality has its particular process of preparing the different grades.

THE CHESAPEAKE PROCESS.

The main object is to get the fish in salt as quickly as possible after they are removed from the water, but first the scales must be removed and the fish washed. In case the seine is hauled on a sandy beach the movements of the dying fish about the sand are sufficient for removing the scales. But when the seine is hauled on a float, sand is sprinkled among the fish, and a few workmen, with high rubber boots, shuffle about among them or they are drudged back and forth by means of a board attached to a long handle. The fish are next washed or rather rinsed to remove

the sand, loose scales, etc. This may be accomplished by dipping basketfuls of them in the water or by placing them in a slat-work box and running water through the mass, stirring them about in the meantime. Some curers scale and wash the fish at the same time, the fish being placed with sand in tubs of water and washed with brooms and then placed in half-barrel tubs with holes in the bottom and sides for draining. About thirty years ago a machine was introduced for scaling fish which was used for a while, but is now discontinued. This consisted of a revolving lattice-work cylinder, having projecting metallic blades arranged upon its inner periphery and sides. The cylinder was filled with fish and revolved in a tank of water, the scales and slime falling through the lattice work and being carried away by the water.

The salting is done in large vats or hogsheads, a convenient size for the vats being 16 feet in length, 5 feet in width, and 2 feet deep, having capacity for about 32 barrels of fish. The bottom of these is first covered with 4 or 5 inches of very strong brine; then put in 8 or 10 barrels of fish, stirring them about as they are being dumped in, and sprinkling more salt on top, following this up with fish and salt, with a heavy covering of salt on top, 6 barrels of salt being used for 32 barrels of fish. In case the fish are being cured in hogsheads, the latter should be half-filled with strong brine, then 4 half-barrel tubs of fish are dumped in, and these covered with half a barrel of Liverpool salt. More fish and salt are then added until the hogshead is filled. After remaining thus for twenty-four hours the herring are stirred with a "breaker," a long stick or pole, flattened at the end, which is about 3 inches in width, and twelve hours thereafter the fish are again stirred. In stirring or "breaking" them in the vats the breaker is run under the mass and then elevated to the surface, the object being to bring the lower layer of fish to the surface and break up the masses which have become bunched together, so that the salting may be uniform throughout.

After remaining over night the fish are "muddled," for the purpose of "pumping" or drawing forth the blood from the gills. This consists in pushing them back and forth with a rectangular board, 5 inches long and 3 inches wide, attached at the upper surface to a long handle, and is done twice daily for six or eight days. Each time the fish are "muddled," during the first four or five days, a quantity of salt is sprinkled over them, about 2 bushels being used the first day, and the quantity gradually decreased.

At the end of seven or eight days, when the fish have become thoroughly struck or cured, they are removed with scoop nets and thrown on racks or stands having open-work bottoms, where they drain for one or two days before packing. When the herring are very abundant and the workmen exceedingly busy the fish sometimes remain on the racks for eight or ten days, but in such cases they are liable to rust. The fish are packed in barrels, with layers of salt between the layers of fish, from 2½ to 3 pecks of salt being used for each barrel. Turk's Island salt is preferred, but Liverpool salt is used to a considerable extent. The former is larger-grained and does not dissolve so quickly, and it also makes the fish sweeter. The fish are placed backs down, excepting the top layer, and those in each layer are placed at right angles to those in the preceding layer. When the barrel is filled it is allowed to settle for a day or two, then topped up with another layer, strong brine added, and the barrel coopered and stored ready for market. The usual number of herring to each barrel is 400, and the weight is generally 160 pounds.

The cost of preparing a barrel of river herring in the Chesapeake region approximates $1.10, of which 35 cents represents the cost of salt, 50 cents the barrel, and 25

cents the labor; the transportation to market costs about 10 cents per barrel, and the commission for selling is 10 cents, making a total cost of $1.30 for preparing and placing the fish on the market. In 1897 pickled river herring sold for about $1.40 per barrel, giving the preparer only 10 cents per barrel for the cost of the green fish, the superintendence, use of plant, and outlay of money. The average selling price in 1898 was advanced to $2.19 per barrel, which gave a fair margin of profit to the curer. Select "all roe" herring sell for about $6 per barrel.

The preparation of "cut" or dressed river herring differs from the above mainly in that the heads and viscera are removed before the fish are washed preparatory to salting. In dressing, the fish are held in the left hand on a cutting board, with the back from the workman, and with one stroke of a knife held in the right hand the head is removed, and a continuation of the stroke cuts off the edge of the belly, laying the fish open from the napes to the vent, the viscera being extracted by a single movement of the fingers. The cutters in the Chesapeake fisheries receive usually 20 cents per 1,000, and an experienced workman can dress 12,000 to 20,000 per day. The fish are then washed and soaked, and in every other particular of salting and packing in the barrel the process is the same as in preparing the gross or round herring. Less salt is required for cut herring, and the number of fish placed in a barrel is about 650, the weight being 160 pounds, as in case of gross herring. The price in 1897 approximated $2.15 per barrel, but in 1898 it was advanced to about $3 per barrel.

THE NEW ENGLAND PROCESS.

About $15,000 worth of pickled alewives are prepared annually on the Maine coast, mostly in the vicinity of Eastport. To Mr. Ansley Hall I am indebted for the following account of the methods in use at that point:

For packing in barrels the alewives are salted round as they come from the water. The parties who handle them at Eastport usually have an agent in the locality where the fish are caught who buys them from the fishermen and salts them temporarily in barrels to preserve them until they reach Eastport, where they are taken out of the barrels and properly cured before being finally packed for shipment. Occasionally the agent cures and packs them, but more frequently he does not. In some instances they are placed on board a transporting vessel which has been sent especially for them and are salted in tubs or hogsheads by the crew. In such cases they are afterward cured and repacked in barrels by the dealer at Eastport.

In salting them temporarily a small quantity of water is first put into the barrel or hogshead, about one bucket in a barrel and four or five buckets in a hogshead. The fish are then put in loosely in layers with salt between each layer and well covered with salt at the top. The quantity of salt required is about half a bushel to each barrel of fish. If they are packed by an agent to be sent to Eastport for curing and repacking, barrels are used. They are allowed to stand about four days before being headed up and the salt is renewed at the top of the barrels as fast as it dissolves. This first salting is done with Liverpool salt. The effect upon the fish is not to permanently cure them, but to strike them so they will keep in good condition for a short time.

When they reach Eastport they are taken out of the barrels and put into the large herring tanks, which hold about 4 hogsheads or 20 barrels each. Each layer of fish is covered with a layer of Cadiz salt and a heavy layer of salt at the top of the tank. In all, about one-half bushel of salt is used to each barrel of fish, or approximately 10 bushels to the tank. A strong pickle is then made and turned in. The pickle contains about 1 peck of Cadiz salt to the barrel of water, and 5 barrels of pickle are necessary to cover the fish in the tank. Boards are then laid across the tank, with heavy stones on them for weights to keep the fish down under the pickle. If the salt on top dissolves, more has to be added. The fish remain in the pickle about 8 weeks. They are then taken out and closely packed in fish barrels, 200 pounds of fish to the barrel. A layer of Cadiz salt is placed between each layer of fish and a heavy layer of salt at the top of the barrel. About 3 pecks of salt are used to each

barrel of fish. The barrels are filled above the chimes and have to stand two or three days to settle before the head can be put in. They are then headed and are ready for shipment. In some instances buyers desire pickle put in, and if so, the barrels are turned over on their side and a 1½-inch hole bored in the bilge, through which pickle is turned in by means of a funnel until the barrel is completely filled. The hole is then plugged. If the buyer does not request it no pickle is put in. It is generally considered that the fish will keep longer without the pickle than with it. It is claimed that the pickle has a tendency to make the fish soft. It is estimated that from the time the alewives are taker fresh until they are cured and packed for shipment about 3 bushels of salt are used to each barrel of fish.

At Waldoboro they are not kept in pickle longer than two or three weeks at most, and are considered in a suitable condition for packing after being in pickle eight or ten days. The quantity of salt used in curing and packing was estimated not to exceed 2 bushels to the barrel.

PICKLING RIVER HERRING IN RUSSIA.

The following method of pickling the large, fat river herring of Russia prevails on the Caspian Sea, this description being furnished by Mr. Schröder, of Stettin, Germany:

The fish are salted in layers, in large reservoirs dug in the ground, protected by a wooden shed, and holding from 60 to 100 barrels. No pickle is poured on them, as it forms of itself, after a few days. In the course of six or eight days the fish are taken out of the reservoirs and packed in barrels, a little salt being sprinkled over each layer. When about three-fourths of the barrel is filled, a mat or sack is laid over the fish, the packer gets into it and tramps them together, the vacant space is packed with tang [a seaweed], the end pressed in by means of a screw and closed. In the uppermost end a bunghole is made, through which is poured a quantity of new boiled pickle, containing from 20 to 25 per cent of salt, the whole being then ready for the market. When the fish are to lie for an indefinite time, ice cellars are made, very conveniently fitted up, and the reservoirs dug beneath them. The Norwegian method, which is much superior, has been tried during the last year and is found to give good results. The salt used in the curing is obtained from salt lakes on the banks of the Volga, and costs from 10 to 15 kopecks per pood. It is found in great abundance, especially on the banks of Lake Basknntschak. The barrels are made of lime wood, about three-quarters of an inch thick, and are fastened with 14 to 16 wooden or 4 iron hoops. When used for sending a long distance they are made of oak, and it is purposed to try birch-wood barrels, as it is thought that birch keeps the pickle better than lime wood. In size they are a little larger than the Norwegian barrels, and contain about 400 fish of average size. A barrel with wooden hoops costs a ruble, iron hoops costing 10 to 15 kopecks more.

BRINE-SALTED COD AND HADDOCK.

The trade in brine-salted cod on the New England coast is small and is confined exclusively to the small fish, under 16 inches split, measured on the back of the fish from the hollow of the nape to the hollow of the tail. A few haddock are also pickled, but hake, pollock, and cusk are rarely placed on the market in this condition, except possibly a few barrels representing a surplus from the Fulton and other fresh-fish markets situated in places where it is not convenient to dry-salt the fish. In pickling cod or haddock the fish are dressed, split, washed, and salted in butts with about 2 pecks of salt to the 100 pounds of fish, in the same manner as has been heretofore noted in preparing dry-salted cod. When orders are received, the fish are removed from the butts, cleaned with brushes, and placed in tight barrels, 200 pounds to the barrel, face side up, except the top layer, which is placed back up, the fish being bent to follow the curve of the barrel, pressure being applied, if necessary, to place the 200 pounds in the package. It is important that the fish be not repacked until thoroughly struck through, otherwise the flesh will be marked with yellow spots caused by contact

of the imperfectly cured fish with one another. Coarse Trapani salt is placed at the bottom of the barrel and over each layer of fish, about 1 peck of salt being used to each barrel of fish. The barrel is then headed and strong brine is added through the bunghole, when the package is ready for shipment. The gross weight of a barrel of codfish, including barrel and pickle, approximates 325 pounds.

It requires about 430 pounds of round cod or 290 pounds of split fish to make a barrel of 200 pounds pickled. If the green fish cost 40 cents per 100 pounds, the cost of preparing a barrel of pickled cod approximates $3.05, divided as follows:

Fish, 430 pounds, at 40 cents per 100 pounds	$1.72
Labor, dressing, splitting, and pickling	.14
Salt used in pickling	.32
Barrel used in packing	.50
Labor of repacking	.07
Cooperage	.05
Wear and tear, loss, etc	.25
Total	3.05

The average price of pickled cod is about $4 per barrel, while haddock are usually worth from 25 to 50 cents less. The market is principally in New York and the West. The annual product on the New England coast ranges from 2,000 to 3,000 barrels.

It appears that there is scope for enlargement of the trade in pickled cod, especially if prepared with great care. Considerable quantities are pickled in Holland, Scotland, Sweden, Belgium, France, and the British North American Provinces. The process employed in each country differs somewhat from that in the United States; the business is conducted more systematically, and the output is much more extensive.

It is generally conceded that the choicest pickled cod are prepared in Holland, those fish selling on the European markets at an equivalent of $11 to $16, and sometimes as high as $25, per barrel of 250 pounds, compared with which the average price of our pickled cod ($4 per barrel) seems very small. Following is the usual process:

As soon as caught each fish is bled by cutting the throat and is then split down the belly from the throat to the tail, the knife running somewhat on the side of the ventral line so as to have the flesh on one side of the dorsal line much larger than the other. The head and three-fourths of the backbone are removed, and the fish immediately washed. The abdominal cavity is well brushed, and to thoroughly cleanse the parts about the remaining portion of the backbone the tail is twisted from left to right and from right to left, and also bent up and down during the process of washing. After being cleansed the fish are packed with dry salt in butts and allowed to make their own pickle. When well struck, usually in five or six days, the fish are repacked in market barrels with some fresh salt between them and with the old pickle poured over all. In packing, the tail of each fish is held in the right hand and the upper portion in the left hand, and the fish so folded that about one-half of the left side is underneath the right side, the body of the fish being bent to follow the curve of the barrel, each layer in the barrel being formed by two fish. The fish should be firm and free from a sodden or flabby condition.

In Scotland the fish are usually bled as soon as caught, and after being split and washed, as in the United States, are placed in butts or barrels with about 75 pounds of Liverpool salt to each 250 pounds of split fish. After remaining there two or three days they are removed, cleansed with brushes, and packed in shipping barrels with about 50 pounds of salt scattered among the fish in each barrel, and strong pickle is then added. Most of these fish are sold in London at from £2 to £3 per barrel.

The process used by the Swedes in pickling codfish differs little from that employed in Scotland, except that Lisbon salt is generally used, and the fish are subjected to considerable compression during the first salting. In Belgium St. Ybes salt is used,

and in repacking, the old pickle from the first salting is added through the bunghole, it being claimed that this old pickle is better than new brine, because it prevents the fish from turning yellow and also gives it a better flavor.

A century ago quantities of codfish were salted in barrels provided with holes near the bottom to permit the brine to leak away. The product was not generally considered so delicately flavored as cod retained in the brine, but in dressing it for the table it swelled, whereas the latter shrinks.

BRINE-SALTED SALMON.

During the last century and the early part of the present a large portion of the salmon taken in the rivers of New England were salted in barrels for local use during the winter and for distant markets. At present, however, practically the entire catch on the Atlantic coast is marketed fresh. Many salmon are salted on the Pacific coast of the United States, especially in Alaska, where the business originated ten years ago, and at one or two points on the coast of Oregon and California, the business in the latter State dating from 1853. In Alaska the red (*Oncorhynchus nerka*), the humpback (*O. gorbuscha*), and the king or chinook salmon (*O. tschawytscha*) are salted, while lower down the coast the silver salmon (*O. kisutch*) is the species generally used, but some chinook are also salted. The annual product is about 25,000 barrels, valued in San Francisco at about $10 per barrel.

Quantities of salmon are also brine salted in the British North American Provinces, especially on the coast of Labrador and Newfoundland, as well as in the Hudson Bay territory. These fish are known in the United States as "Halifax salmon." The trade began early in the present century, and since 1840 has ranged between 3,000 and 10,000 barrels annually, the present annual receipts averaging 5,500 barrels, valued at about $15 per barrel. In the fisheries of northern Europe and Asia salmon are also salted, but it is unusual for any of the product to be received in this country.

In dressing salmon for pickling on the Pacific coast, the heads are removed and the fish split along the belly, the cut ending with a downward curve on the tail. The viscera and two-thirds of the backbone are removed, and the blood, gurry, and black stomach membrane scraped away. The fish are then thrown into washing tubs, the red-fleshed and the pale-fleshed fish being placed in separate tubs and soaked sufficiently to make them perfectly free from blood, and thoroughly cleaned with a brush or broom. They are next placed in pickling butts with about 15 pounds of salt to every 100 pounds of fish, and sometimes a little saltpeter is used to increase and set the pink color. The fish remain in the salting butts about one week, when they are removed, rubbed clean with a scrub brush, and repacked in market barrels, one sack of salt being used to every three barrels of 200 pounds each. At some of the salting establishments the fish are salted in the barrels without being first placed in butts, but these are usually repacked in San Francisco. The barrels used in packing salted salmon in Alaska are generally made of native woods at the salteries, a stock being prepared before the salmon season.

The following notes on salting salmon in Alaska are furnished by Mr. A. B. Alexander:

The demand for salt salmon is yearly increasing. A few years ago there was but little call for it, probably owing to the fact that little effort was made on the part of those engaged in the business to introduce it in the East. Seeing the absolute necessity of taking steps to place their products on

the Eastern market in order to increase the demand and establish a trade for salt-cured salmon, efforts have been pushed in that direction, and the encouragement met with has induced many who had not the means or desire to enter into the expensive business of canning salmon to establish salmon salteries in various parts of Alaska. The amount of capital required to start on a small scale in this business is not large. One or two boats fitted with drag seines, a cabin on shore for living quarters, a rough shed or fish house in which to dress and salt the fish and for performing such general work as may be required in a limited business of this kind will suffice for all purposes. Many of the well-established salteries were first started in this manner and have since grown to be of considerable importance. Two or three men with only a small amount of capital, if they are fortunate in selecting a good locality where the run of salmon can be relied upon—for the success of the entire business depends upon the location—can, if they display the required amount of energy, build up a paying business. They of course must appreciate the fact that for at least seven months out of the year they must content themselves with being cut off and isolated from civilization; but the class of men who seek a livelihood in this remote part of the world care little for social life, or, if so, the prospect which looms up before them for making money is fully equivalent to any hardships of this nature they may undergo. Several small vessels manned by men of small means have, during the past few years, made annual voyages to Alaska, spent the fishing season there, and in the fall brought back the summer's catch. At first they temporarily located themselves by way of an experiment where it was thought to be a good position for carrying on the business. If the experiment proved a success, the next year greater preparations were made, and in this way from a small beginning quite a number of valuable plants have been established. The greater part of the salmon put up at the salteries are caught in drag seines, although a few are taken in gill nets and traps, but at most places where salteries are situated the drag seine has been found to be the most profitable apparatus of capture, owing to the great number of smooth beaches where the fish can be easily taken.

All barrels used for putting up salmon in southeastern Alaska are manufactured at the salteries. Suitable wood being abundant, they can be made at a reasonable price. During the winter months enough barrels are made to meet the demand for the coming season. A cooper is an indispensable person about a salmon saltery, for, besides performing his regular duties as a cooper, he is often called upon to assist in various mechanical jobs, and is paid by the piece, or so much per barrel—85 cents for making a whole barrel and 65 cents for a half barrel. At this price he can earn good wages, for he is under no expense for board. It being the object of every man owning a saltery to enlarge on the plant and increase his business as rapidly as possible, several weeks of each year, before and after the fishing season, are spent in building wharves, if needed, erecting buildings, and making such improvements as are required to keep a place of this kind in good order. Many salmon salters have gained a firmer foothold in Alaska than the mere business of salting salmon would give them. They have branched out into general trade and have stores well stocked with goods of all kinds. In this way they have drawn around them the neighboring tribes of Indians, who are ever ready to buy and trade for such commodities as they require.

In Sweden the choicest pickled salmon are the "ice-house salted salmon." These are killed as soon as caught, split and eviscerated, and the head and larger portion of the backbone removed. Each fish is then rubbed with a mixture of salt and sugar and carefully placed, skin upward, except the bottom layer, in barrels and covered with brine. These barrels are stored in ice-houses or cool cellars and kept at a low temperature.

The following method of brine-salting salmon was practiced in Scotland a hundred years ago:*

The Scotch salmon is not too fat, a circumstance which contributes much to its preservation. As soon as possible after they return from fishing, they split the salmon in the same manner as is done with flat cod, except that cod is cut along the belly, and salmon along the back from the head to where the fin of the tail begins, and often leave the large bone sticking to the flesh of one of the sides. Having cut the fish in this manner, taken out the gills, emptied it, and, sometimes, taken off a part of the large bone, they wash it in sea water, if they have it convenient to them, or, if not, in fresh water,

* A treatise on fishing for herring, cod, and salmon and of curing or preserving them, published by order of the Dublin Society, Dublin, 1800. pp. 140-141.

to take out all the blood, which has a great tendency to putrefaction. This seems to be a much better method than that of washing the fish in its own blood, as is used in the North, probably for the purpose of making the flesh redder. When the fish has dripped they put it into large tubs, with French or Spanish salt over it and under it. It is supposed that Spanish salt gives it a more reddish color than French salt, but that French salt gives it a less sharp taste. Some leave the fish in salt for eight or ten days and then barrel them. Others put them without salt into large tubs, filled with strong brine, and leave them there for a month or six weeks and sometimes longer, waiting until there may be a call for them, for it is thought that salmon keeps better in those large vessels than in barrels, but care must be taken to have it constantly covered with brine. Lastly, it is to be taken out of the tubs and barreled. In the bottom of the barrel they put four or five small salmon and then lay on the large, good salmon, pressing them together as much as possible and putting a little salt between them. In the top of the barrel, likewise, they put some small salmon. When the barrel is full they pour in a small quantity of strong brine and immediately close it up, for it is necessary to guard the fish against the contact of the air and to prevent the brine from being lost. Without these precautions the salmon would grow yellow and rusty and would contract a bad smell. Large salmon is more liable to these inconveniences than the smaller sort, and, therefore, requires more salt in the barreling of it. It is more difficult to preserve salmon than cod. The Scotch take care not to mix salmon of different sorts and qualities in the same barrels, and not to export such as are bad. There is a bounty on every barrel exported, and there are inspectors in every port of Scotland whose business it is to inquire into and certify the good quality, species, etc., of the fish. When the barrels arrive at their place of destination, they ought to be filled again with fresh brine.

BRINE-SALTED MULLET.

Mullet is the most important fish brine-salted in the Southern States, more of this species being pickled than all others combined, the product being especially large on the coasts of North Carolina and Florida, where about 6,000 barrels are prepared annually between the middle of August and the end of November.

As soon as removed from the seines and carried ashore the mullet are dressed. This consists in splitting them down the back and underneath the backbone from the head to the tail, so that the fish will lay out flat, and removing the viscera, stomach membrane, and gills. On the coast of Florida, where the mullet are very large, the heads are removed, and sometimes the backbones, but this is not the case on the Carolina coasts. A horizontal gash is sometimes cut in the thick portion of the flesh on the side in which the backbone is left, in order that the brine may easily penetrate it. The fish are next immersed in tubs or barrels of clean salt water and soaked for about half an hour and the blood and slime washed off. They are removed one at a time and salted with the hand, the salt being rubbed both inside and outside. Then they are usually placed, flesh side up, in old boxes or barrels of any description that are clean, with salt sprinkled over each layer of fish. Generally this work is done by the fishermen and their assistants, and on the North Carolina coast they take them to market in two or three days and sell them to the packers, who are usually wholesale grocers or dealers in fresh and salt fish, by whom the mullet are at once repacked. In other localities, and especially on the west Florida coast, the repacking is generally done by the fishermen.

In repacking the mullet are removed from the first package and placed in layers, with the face or inside of the fish up, in new white pine barrels, 100 pounds being put in each package. In order to permit the brine to easily permeate the contents of the barrel, the fish of one layer are sometimes placed at right angles to those in the layer below. Strong brine of not less than 95° test, or, as usually determined by the fishermen, strong enough to float a mullet, is then poured in until the barrel is

full, when the barrel is coopered and set aside and sold to the trade. In some cases, instead of making new brine, the pickle resulting from the first salting is boiled in large kettles, strained, cooled, and poured over the fish, and dry salt is frequently sprinkled over each layer of fish as they are placed in the barrel. It requires half a bushel of salt to strike and pickle 100 pounds of mullet. The decrease in weight by dressing, when only the viscera and gills are removed, approximates 15 per cent, and the decrease in weight by curing is about 10 per cent.

The fishermen sell the partly salted mullet to the dealers at prices ranging from $1.50 to $3.50 per 100 pounds, and after pickling them the dealers usually sell them for from $2.50 to $4.50 per barrel of 100 pounds, the quality and full weight of the fish being guaranteed by the dealer who puts them up. According to the inspection laws of North Carolina, mullet are divided into three grades—those taken in gill nets of 2-inch mesh being called 2-inch mullet and branded as "number one"; $1\frac{1}{2}$-inch mullet, "number two"; 1-inch and under, "number three"; and fish of different lengths and kinds are designated "mixed."

In North Carolina it is required, by an enactment of 1879, that barrels used in packing mullet shall have staves 25 inches in length and heads 13 inches in diameter. They are made generally of Maine white pine, and cost from 45 to 60 cents each. Packages made from the long-leaf pine grown in the Southern States should never be used, since the fish are liable to be flavored with the turpentine. Mullet are also placed in quarter barrels containing 50 pounds, in full barrels of 200 pounds capacity, and in kits of 10 and 15 pounds each.

If the fish are kept on hand long they are examined from time to time by removing the barrel heads, and if the pickle has leaked out more is added, for the fish must be kept under pickle to prevent their rusting and spoiling. They are also liable to rust if kept in the first salting longer than one week. Pickled mullet are at their best after they have been pickled from one to six weeks; after that they begin to deteriorate in quality, and after six months they become so strong that they are not very palatable and few are then sold.

The full value of pickled mullet is scarcely appreciated on our South Atlantic and Gulf of Mexico coasts, and there are stretches hundreds of miles in extent where none whatever are prepared, notwithstanding the fact that the fish are abundant and the industry would yield remunerative employment to the fishermen of the locality. Even where mullet are prepared many of the fishermen are unfamiliar with the best methods of cure, and some mullet are put up in so crude a manner as to injure the trade by prejudicing the public against eating these fish. Pickled mullet properly cured are among the choicest of our Southern fishery products, and if careful attention be given to their preparation, with suitable restrictions against marketing inferior products, a large trade in them could be established, and, because of their great abundance, without in any way conflicting with the supply for the fresh-fish markets.

BRINE-SALTED SHAD.

During the early part of the present century pickled shad was an important fishery product, large quantities being salted in barrels, either for local use during the winter or for shipment to distant markets. It was a staple winter food for the people living near the shad streams, most of the families who could afford it laying in from 1 to 5 or 6 barrels. People living 50 miles or more inland came to the streams

to obtain their winter supply of fish, bringing their products to exchange, such as maple sugar and salt, or cider and whisky; and sometimes the fishermen sold to traders, who carted the fish inland, exchanging them for what they could get.

Shad are yet salted to some extent on Kennebec River, in Casco Bay, on Delaware River, the tributaries of the Chesapeake, and in the Carolinas. The bulk of those on the Boston market come from Canada, while of the domestic product the coast and rivers of Maine and the Chesapeake region furnish the greater number. Those salted in the Southern States are usually eaten in the homes of the fishermen or in the immediate neighborhood. There is no uniform method of preparation, the dressing of the fish, the salting, and the packing varying according to the experience or fancies of the different curers; but the following are the most general processes when the fish are to be placed on the market.

KENNEBEC RIVER PROCESS.

The shad are first beheaded and split along the belly, eviscerated, and about 6 inches of the upper portion of the backbone removed. They are next washed thoroughly, some curers washing them in two waters, allowing them to soak five or six hours in the second washing. After the soaking the end of the tail is sometimes cut off. The shad are then ready for salting. In this operation a layer of salt is placed in the bottom of a barrel or butt, and this is followed by successive layers of fish and salt, the former with the backs down, about a bushel of salt to each 200 pounds of split fish. It is desirable to rub the salt over the face or flesh side of the shad before placing in the barrel. In a few days the fish in the top layer are turned backs up and a weight is put on them to keep them beneath the pickle, and a small quantity of salt placed over all to strengthen the weak pickle floating at the top. The shad may remain in the pickle a month or more, but usually two weeks or even less is sufficient time for the curing. On removal they are rinsed off in the pickle, culled if the quantity warrants, weighed in lots of 200 pounds each, and packed backs down in tight barrels, with salt scattered at the bottom of the barrel and over each layer of fish, about half a bushel of salt being used for each barrel.

Liverpool salt is used almost exclusively, for striking or curing and for repacking. Trapani salt is objectionable, as its coarse grains lacerate the smooth surface of the shad. After 200 pounds of fish have been placed in the barrel, the latter is filled with strained pickle from the curing or first packing and the head is put on, when the barrel is ready for branding and shipment; or, better still, after the barrel is headed and its contents have settled somewhat it is turned on its side and additional pickle added through the bung. When properly prepared, pickled shad should keep from 12 to 24 months. The shrinkage from dressing and salting is about 50 per cent, 400 pounds of round shad being required to make a barrel of 200 pounds salted, the number of fish to the barrel ranging from 75 to 120. The price received is usually $8 or $10 per barrel.

THE CHESAPEAKE PROCESS.

On the tributaries of Chesapeake Bay the roe shad are rarely salted, on account of the demand for them in the fresh-fish markets, and as a rule it is only during a glut in those markets that the bucks or males are salted. In preparing the fish the heads and tails are cut off and the fish cut down the back to the tail and thrown in tubs or

vats of water where they soak for an hour or so, the blood within the backbone being scraped out with a knife in the meantime, when the water should be renewed or the fish placed in other tubs. Upon completion of the washing and soaking, the fish are drained and put in vats with dry Liverpool salt at the bottom, and over each layer of fish, and on top. Every 12 hours thereafter for 7 days the fish are stirred with a pole, to separate them from each other and to have all portions uniformly salted, thus avoiding spots caused by salt burning.

On the eighth day the fish should be removed, drained, and packed in barrels. First is placed a sprinkling of Turks Island salt, then a layer of shad, backs down, then a sprinkling of salt and another layer of fish, backs up, and so on until the barrel is full; and after the fish have settled for a day or so the barrel is topped up with other fish and then filled with strong pickle made of Liverpool salt, when it is coopered and stored ready for market. The usual wholesale price for salted buck shad is $7.50 per barrel of 180 pounds.

The salting of shad was once an important industry on the Connecticut River and on Long Island Sound near the mouth of that stream, and there is a provision among the laws of Connecticut requiring that—

> Pickled shad intended for market shall be split and well cleansed and pickled in strong brine, and shall remain in such brine at least 15 days before they shall be put up for market, and shall be put up in barrels or half-barrels, the barrels containing 200 pounds each, and the half-barrels 100 pounds each, of fish well packed, with a sufficient quantity of salt, and filled with strong brine; and shad so put up shall be of three denominations, to wit: Shad "number one," to consist wholly of shad well saved, free from rust or any defect, with the head and tail cut off and the backbone cut out, each barrel to contain not more than 80 shad, and each half-barrel not more than 40. The second denomination shall be shad "number two," to consist wholly of those well saved, trimmed, pickled, and prepared for packing in the same manner as shad number one, each barrel to contain not more than 90 shad, and each half-barrel not more than 45. The third denomination shall be shad "number three," to consist of such as will not answer for either of the two former numbers, well saved, with the heads taken off.

The legislature of Maine, in 1828, required that shad pickled in that State should be branded as follows:

> Those of the best quality, caught in the right season, to be most approved and free from damage, having their tails cut off and backbones out, shall be branded "cargo mess"; those which remain after the best have been selected, being sweet and free from taint, rust, or damage, with their backbones in and tails on, shall be branded "cargo No. 1"; and there shall be a third quality, which shall consist of the thinnest and poorest of those that are sweet and wholesome, which shall be branded "cargo No. 2."

BRINE-SALTED SWORDFISH.

Most of the swordfish captured on the New England coast are sold fresh, yet sometimes a glut in the market or the exigencies of the fishery make it desirable that they be preserved in more permanent form, and pickling in brine is the process usually adopted. In dressing, the swords are sawed off and discarded and the heads removed with a large knife and saved for the oil factories. The fish is then split down the belly and the viscera removed. The splitting is continued down to the tail and around the back, the backbone removed, and the fins and tail cut off. The fish is then cut into pieces weighing 4 or 5 pounds each and placed in butts with a heavy sprinkling of salt, about 2½ bushels of Trapani salt being used to each 1,000 pounds of fish. Any time after 10 days or 2 weeks the fish are repacked in shipping barrels—200 pounds to the barrel—with a small quantity of salt sprinkled among them. The barrel is then filled with pickle and headed up.

Because of its being so fat, the shrinkage of swordfish in pickling is very great, amounting sometimes to 30 per cent of the weight after it has been beheaded and eviscerated. When the pickling is done on board vessel the fish are placed with salt in barrels in the same manner as in the butts, and are repacked ashore in order to insure the proper weight in the barrel, a small quantity of salt being added usually in the repacking, or the fish may be repacked in the original pickle.

The market for the product exists principally in the interior of New England, and especially in Connecticut, where many persons consider it more palatable than salted mackerel. The wholesale price is generally about the same as for No. 3 mackerel, averaging from $6 to $8 per barrel.

A fair idea of the cost and profit in pickling swordfish ashore may be obtained from the following figures, representing the handling of 4,043 pounds of pickled fish, the shrinkage from dressing and pickling amounting to 1,787 pounds:

Swordfish (5,830 pounds, at 1¼ cents)	$72.87	Pickled swordfish:	
Salt	3.07	15 barrels, at $6.50	$97.50
Labor, cutting and pickling	5.84	10 half-barrels, at $3.45	34.50
Barrels, 15 at 25 cents	3.75	43 pounds, at 3¼ cents	1.40
Half-barrels, 10 at 16 cents	1.60		
Cartage, 15 barrels, at 7 cents	1.05		
10 half-barrels, at 3½ cents	.35		
Interest, wear and tear, and profit	44.87		
	133.40		133.40

BRINE-SALTING FISH ON THE GREAT LAKES.

Large quantities of trout, whitefish, herring, pike, pickerel, saugers, suckers and other species of Great Lakes fish, were formerly salted each year, but the increased trade in fresh fish and the development of the frozen-fish business have resulted in a large decrease in the product of salt fish. The most profitable disposition of fish on the Great Lakes is in the fresh-fish markets, and when the supply is in excess of the demand the surplus is generally frozen, the salters receiving only the surplus after both the fresh and frozen trades have been supplied, the fish that are salted being only such as can not be sold with profit, either fresh or frozen. Many of these fish are salted immediately after removal from the nets; others are sent to the large ports packed in ice for the fresh trade, but on a glut developing in the market they are salted, and a small quantity consists of fish which have been frozen, but are finally salted because of exigencies in the frozen-fish trade or because of fault in the freezing. Frozen fish are not so satisfactory for pickling as are fresh fish, because of their great tendency to rust, but they are equally good for smoking.

The methods of salting fish on the Great Lakes are essentially the same for the various species, differing only slightly in the manner of splitting. They are laid open flat by splitting down the back or down the belly to the tail, or in case of ciscoes they are split down the belly only sufficiently to remove the viscera, similar to the split herring on the New England coast. The fish bring a higher price if split down the back, and when salted directly from the nets that is the usual method of dressing, but many of the large ones have already been split down the belly to the vent in dressing for the fresh-fish trade, and in that case the splitting is continued down to the tail, so that the fish may be laid out flat. Trout are generally split down the back if salted by the fishermen, but most of those on the market are from the fresh-fish

houses and consequently have been split down the belly, and the same is to some extent true in regard to whitefish, but the proportion of salted whitefish split down the back is greater than in case of trout. Blue pike, yellow pike, mullet, sheepshead, perch, and carp are usually split down the back, even though prepared as surplus from the fresh-fish trade, since they are usually sold round in the fresh fish-markets. Herring split down the belly to the vent sufficiently to remove the viscera are commonly called ciscoes, but many herring are split down the back and sold under the trade name of "family whitefish." The difference in value of fish when split down the back and when split down the belly is shown in that species. Although the ciscoes and the family whitefish are prepared from the same grade of fish, yet the latter usually sells for about 50 cents per 100 pounds more than the ciscoes. It is much easier and quicker to split herring for ciscoes than for family whitefish, 500 pounds of ciscoes being readily split in one hour, whereas twice that length of time is required for splitting an equal quantity of family whitefish. Not so many ciscoes are prepared now as a few years ago, since the increased value of the fish makes the better method of cure profitable.

On arrival at the salting house, if the fish have already been eviscerated, the heads are cut off and the splitting continued down to the tail, so that the fish will lie flat. In case the fish are round when received, they are beheaded and cut down the back along the left side of the backbone, so as to lie flat, except in case of ciscoes, as above noted, and the rough edges of the backbone are cut off. The flat edge of the knife is run around the abdominal cavity to scrape away the blood, etc., and if the fish are large, one or two horizontal deep cuts are made in the thick flesh of the back. The fish are then thrown into a trough containing fresh water, where they soak for a few minutes and are removed with a pew or fork and thrown on a draining and salting table, three-fourths of the top of which consists of strips on edge, on which the fish lie to drain, and the remaining one-fourth of the width is solid for holding the salt. After draining a few moments, each fish is taken separately, laid back down on the salt if large, and a quantity of salt spread evenly over the face, and the fish carefully placed face up in a tight barrel. For protection from dust, etc., the top layer is placed skin up. In salting small fish, one is taken in each hand and rubbed in the salt, as in salting mackerel.

In case of ciscoes, the stomach cavities are scraped full of salt and closed and the fish are thrown into the pickling barrel.

In order to avoid lacerating the flesh of the fish it is necessary to use fine salt, either Syracuse or Warsaw being preferred. The former is a solar salt and weighs about 336 pounds per barrel, and the latter, a pan salt, weighs about 290 pounds per barrel, and the cost of each ranges from 90 cents to $1 per barrel, the Warsaw being usually a few cents cheaper than the Syracuse. Cleveland salt is also used to some extent in striking. Some salt is sprinkled in the bottom of the barrel and several handfuls placed on top of the fish, and weights placed thereon to keep the fish down in the pickle, these weights consisting usually of stones on top of boards. No brine is added, the fish making their own pickle. The entire quantity of salt used for each 100 pounds of green fish ranges from 12 to 15 pounds, according to the size and condition of the fish and the season. Fish that have been frozen do not require so much salt as fresh fish, since they are somewhat drier and the texture is to some extent disintegrated, permitting the salt to strike through the fish more readily. Within four or five days the fish are struck through, depending on the grade of salt,

size of the fish, and the temperature, and at any time thereafter they may be removed and repacked. This should be done at the first convenient opportunity, for the longer the fish remain in the pickling barrel or vat after being cured the darker they will be, which detracts from their value.

On removal from the pickling barrel the fish are rinsed in the pickle to get rid of the surplus salt and at once weighed and repacked in the shipping packages, which consist almost entirely of half-barrels with capacity for 100 pounds. These are made mostly in Sandusky, and cost from 40 to 45 cents each. The fish are carefully placed face up, except the two top layers, which are placed with the skin side up as a protection from the head of the barrel. Salt is sprinkled in the bottom of the barrel, at the top, and at intervals among the layers of fish, about 8 pounds being used for each 100 pounds of fish. Syracuse salt No. 2 is usually preferred for packing, even though Warsaw or Cleveland salt has been used in striking. When the package is full of fish strong brine is poured in to fill the interstices between the fish. This brine is made by permitting water to percolate through a box or tank, the lower part of which is filled with some filtering substance, such as straw or plane shavings, and the upper part filled with salt; or the filtering box may have a false bottom covered with burlap, the salt resting above the burlap and the brine percolating through and remaining in a tank below. In case the salting establishment is connected with an ice-and-salt cold storage the surplus brine from the ice-and-salt receptacles may be used with excellent result, this brine being permitted to flow from the receptacles into a large filtering tank sunk in the ground, from which it may be pumped as required. The strength of the brine usually depends on the season of the year and the grade of fish being packed. In the summer packing of whitefish or trout the brine should be of 100° salinometer test. But in October and November packing of herring, brine of even 60° test is frequently used, this being made by weakening stronger brine with fresh water. This use of diluted or weak brine is satisfactory when the packer is assured that the fish will be used before spring; but in packing fish for the general trade, where they may not be used until the following summer, the brine should not be weaker than 95°, and 100° test is much better.

When the package is filled with brine the top is coopered on and additional pickle admitted through a hole in the head of the barrel by means of a funnel watering-pot, the barrel being overfilled to permit the pickle to soak in. In a few hours a plug is driven in the hole and the tightness of the head is tested by pressing on it in the center.

The decrease in dressing fish ranges from 15 to 35 per cent of the round weight, according to the species of fish and the season of the year. The decrease is least in case of herring and blue pike and is greatest with mullet and carp, but it varies in different seasons of the year, according to the development of the ovaries. The decrease in weight of Great Lakes fish in pickling ranges from 8 to 12 per cent of the dressed weight, according to the fatness of the fish and the extent of the salting. The decrease in herring is about 9 per cent of the dressed weight, 110 pounds of split fish being necessary to make a 100-pound package of salted fish. Whitefish, being fatter than herring, decrease more in weight in salting and consequently are drier, the salt absorbing the fat. Generally, in case of whitefish, trout, and herring, about 132 pounds of round fish are required for each 100 pounds of pickled fish. In brine-salting trout, 130 pounds round, 115 pounds from the ice, or 105 pounds from the knife are required for each 100-pound package.

Aside from the first cost of the fish and the cost of plant, superintendence, etc., the expense in preparing pickled Great Lakes fish is about the same for the various species and approximates 69 cents per package of 100 pounds, divided as follows:

Labor in dressing and salting	$0.12
Salt in striking and packing	.07
Labor in packing, coopering, etc	.08
Barrel	.42

Whitefish are generally divided into three grades—Nos. 1, 2, and 3. In the first class are placed all weighing 2 pounds and over; No. 2 includes all weighing between 1 and 2, and No. 3 includes all under 1 pound in weight.

Prior to 1891 there was only one grade of trout, but it has since been customary to brand trout weighing 1½ pounds or more as No. 1 and all under that weight as No. 2.

BRINE-SALTED HALIBUT FINS.

The strips of flesh attached to the inner bones of the dorsal and ventral fins of the halibut are cut off in dressing these fish for use by the smokers, and are subsequently pickled; but in case of the fresh-halibut trade the fins are not removed, but are shipped with the fish. In dressing halibut for the smokehouses, the "feathers" or "fly" of the fins are first cut away, then with the point of the fletching knife the skin is cut on each side of the fin about 2 inches from the edge, and by a sharp stroke near the tail that end is separated, and catching hold thereof the whole fin is pulled off, the two fins representing about 3 or 4 per cent of the weight of the round halibut. They are placed in tiers in tight barrels, with salt sprinkled in the bottom and over each layer, about 1 bushel of salt being used to each 200 pounds. On being landed from the vessel the pickled fins are frequently repacked in half-barrels and other small packages, and they are used mostly as ship stores.

Several years ago pickled-halibut fins sold at $8 to $10 per barrel of 200 pounds, but the price gradually decreased to about half that amount. In 1898 they sold at about $8. This fluctuation is due to the fact that during the Iceland fishery a large percentage of the halibut were too small to warrant saving the fins, and the demand for ship stores being good, the market was not overstocked. When the Iceland fishery was abandoned for Bacalieu and other western banks the average size of the fish caught was much increased, so that many more fins were salted. This, together with a decreasing demand, greatly overstocked the market and ran the price down very low, so that in 1897 and 1898 very few vessels saved the fins. The small product resulted in equalizing the supply and demand, and in 1898 the price was advanced to nearly its former standing.

MISCELLANEOUS BRINE-SALTING.

All along the coast of the United States a small local business is carried on in pickling fish for use during the winter in the homes of fishermen and their neighbors. Among the species thus prepared are bluefish, squetague or sea trout, channel bass, croakers, perch, sheepshead, Spanish mackerel, striped bass, black bass, hogfish, etc. There is no uniform method of pickling, the fish being dressed, salted, and packed according to the fancies and convenience of the curers, and the product rarely goes on the general market. In general, the fish are dressed by removing the head and

viscera, and are split down the back or sometimes the belly, so as to lie out flat. They are next washed and soaked until the blood is removed and then covered with salt and placed in barrels, first a sprinkling of salt and then a layer of fish, and so on until the barrel is filled. Then brine is poured in to fill the interstices and the barrel is headed and coopered.

In Europe a large variety of marine products are brine-salted, most of them being prepared from species of the herring family. The following descriptions apply to the method of preparing a number of them:

PRESSED SARDINES.

The "pressed sardines" of Sweden are prepared in the following manner:

As soon as the sardines are caught they are thoroughly eviscerated, cleansed, and salted in layers in large vats, 65 pounds of salt being used to 100 pounds of fish, this salt being thoroughly sprinkled between the layers of fish. Within two or three days brine forms and covers the fish, and there they remain for one or two, and sometimes three months—the longer the better. When ready for repacking, the sardines are laid flat in the barrel with their tails pointing toward the center, while before they were placed in layers. The barrel is thus filled to within 4 inches of the top, and over the fish is placed a sheet of paper, and upon that a thin board which is smaller than the opening of the barrel, and lastly a wooden block which measures one-fifth the height of the barrel. By means of a screw the wooden block and the fish underneath are slowly pressed down; then the block is removed and the space filled with more sardines, until the barrel is overfull. A sheet of paper and another thin board are put on the fish and pressed down like the first, when the barrel hoops are loosened, the cover placed on, and the barrel tightly sealed. The barrels are provided with small holes, so that the oil and moisture may run off. A barrel of 40 gallons capacity will hold from 3,000 to 8,000 pressed sardines.

SALTED PILCHARDS OR FUMADOES.

Somewhat similar to the above is the English process of preparing pilchards (*Clupea pilchardus*) in the form of fumadoes* for the Italian markets, which is thus described in Holdsworth's Sea Fisheries:

The curing is the especial work of the women, who pack the pilchards in alternate layers of coarse salt and fish on the stone floor of the curing house until the "bulk" has reached a height of 5 or 6 feet. Here the fish remain for a month, and the oil and brine draining from them are carried off by gutters in the floor to a cistern. When the fish have been sufficiently salted, they are washed and packed in hogsheads, each layer of fish being placed with their heads outward and with a "rose" of fish in the center. A circular piece of wood called a "buckler," and rather smaller than the head of the cask, is then placed on the top of the fish and strong but gradual pressure is applied by means of a lever until the mass of fish is reduced one-third in bulk and a great quantity of oil squeezed from them. This drains through the sides and bottom of the cask, the hoops of which are not at that time very tightly driven, and is collected as before. The quantity of oil obtained from the pilchards depends on the season, but at least 2 gallons of oil are expected from each hogshead. It is principally used by the leather-dressers. The cask is filled up three times before the pressing is finished, which is not until after eight or nine days, and then the hogshead (50 gallons) of fish should weigh 4 cwt. gross. The average number of fish packed in a hogshead is about 2,500. The pilchards cured at St. Ives in the early part of the season are mostly taken by drift nets, but the seine fishery at a later period is mainly depended on to provide the fish for exportation.

A large trade in pickled pilchards is carried on between Cornwall and the Italian ports, according to Francis Day, the idea having originated at Mevagissey, as follows:

In 1876 [*Land and Water*, November 18, 1882], a fish-curer here found there was a demand in the Mediterranean fish markets for bright salted pilchards. He first thought the matter out and then cured several tons of pilchards by throwing them, with salt, into barrels, and allowing the brine to

* As may be inferred from the name, these fish were formerly smoked. William Borlase noted, in 1758, "fuming them being for many years laid aside."

rise over them. After keeping them steeped for some weeks they were washed, packed, and pressed into clean barrels, just as was formerly done to the old-fashioned fumadoes. On their being put on the market it was at once seen they were the article wanted; for these fish, instead of having the dirty yellow hue of the fumado, had the desired bright and clean silvery color, hence they have been in demand ever since. The fish-curer in question took out no patent rights, but allowed all to use his discovery; so much so that for some seasons past not less than 1,000 hogsheads of fish yearly have been shipped for the Mediterranean from Mevagissey alone. The barrels first used have been superseded by large steeping vats, one of which here will hold over 500,000 fish. Since the business in question has been progressing, it has been discovered that the Spaniards cure sardines much after the same manner.

Pickled pilchards are not so well flavored as salted pilchards, or fumadoes, but they will keep a much longer time, it being necessary to dispose of the latter within a short time after curing.

ITALIAN SARDELS.

The method of preparing the celebrated and deliciously-flavored sardels of Italy is as follows:

After the freshly caught sardels or anchovies (*Engraulis encrasicholus*) have been well salted and washed they are cleaned and the lower jawbone is removed and the fish strongly salted in a barrel with 50 pounds of salt to 100 pounds of fish. There the fish remain for two or three months, when they are removed and loosely packed in the market barrel or package, being resalted at the same time, 25 pounds of salt being used to each 100 pounds of fish. The barrel is set upright, and after three or four months the blood pickle is poured off through a bunghole. During this time the barrel is placed in the sun, so that the pickle has become quite strong, and sometimes a little ocher is added to the pickle to give it a dark-red color. The fish may then be used within a few weeks, but to acquire its best flavor about three years are required.

GÄHRFISCH OR FERMENTATION FISH.

In some of the districts of northern Sweden there is a unique method of preserving fish, the product being known as "gährfisch" or fermentation fish. Various species are used, but mostly the stromling or Swedish anchovy. The freshly caught anchovies, after being dressed and thoroughly washed, are lightly salted and loosely packed in tight wooden barrels. A blood pickle made from the dressings of the fish is then poured over them until all the fish are covered, when the barrel is tightly sealed. It is then placed where the sun's rays can reach it, and there it remains four or five weeks, the fish undergoing fermentation. If this fermentation be too rapid the barrel is removed to a cooler place, and as soon as the fermentation has taken place the barrel is opened and its contents repacked in smaller packages, which must be kept securely sealed, otherwise putrefaction quickly ensues. These fermentation fish are eaten either raw or cooked, but the market is limited to northern Sweden. The odor is very strong and excites a feeling of disgust among persons unaccustomed to eating them, but when a taste for the fish has been acquired they are highly relished.

SAHLSTRÖM PROCESS OF BRINE-SALTING FISH.

A method of pickling fish, intended especially for herring, was devised about fifteen years ago by Carl A. Sahlström, and has been used to some extent in Norway and Scotland. It is somewhat similar to the Roosen process of preserving fish fresh by means of an antiseptic, and consists, first, in placing the dressed fish in a closed cylinder, into which brine is introduced until the cylinder is full. Additional brine is

then forced into this cylinder under a pressure of from 60 to 100 pounds to the square inch, thus forcing it into the tissues of the fish. The fish can be salted sufficiently to suit the necessities of the market, and the operation requires a less number of hours than the ordinary process requires weeks. The tissues are thoroughly permeated by the preserving liquid and are quite incapable of supporting organisms of putrefaction.

PICKLING WITH VINEGAR AND SPICES.

Pickling with vinegar and spices is one of the ancient forms of preserving fishery products, probably antedating even the pickling with salt. It was well known to the Greeks and Romans, the latter applying it especially to preserving mullet, swordfish, tunny, etc. The most costly spices were used, and the products frequently sold at fabulous prices. At present comparatively few fish are preserved in this manner and the business is done on a small scale. Many small herring are compounded with vinegar and spices and marketed as Russian sardines, and there is some importation from Europe of herring somewhat similarly prepared, which are sold as Christiania anchovies, marinated herring, spiced herring, etc. A small business is done in pickling eels, sturgeon, and one or two other species with vinegar; and oysters, clams, and mussels are frequently put up with this antiseptic in glass jars, but the business is of small extent.

RUSSIAN SARDINES.

The preparation of Russian sardines, or small pickled herring in vinegar and spices, is of comparatively recent origin in this country, being first undertaken by Mr. Henry Sellman in 1874, at about the time of the beginning of the Maine sardine industry. The business, which is not very extensive, is carried on in connection with the preparation of sardines on the coast of Maine. The fish used are similar to those canned in oil, varying in length from 7 to 12 inches alive and from 5 to 9 inches when dressed. As the herring are more valuable when canned they are so prepared when practicable; but when more fish are received than the canneries can handle the surplus is salted and prepared under the trade name, Russian sardines.

For many years previous to 1860 Russian sardines were prepared at various points in Europe, and especially at Hamburg, Germany, and the trade extended to this country. By 1870 the importation of this product into the United States amounted to 50,000 kegs per annum, nearly all of which came from Hamburg. In consequence of the blockading of the German ports in the early part of the Franco-German war the importation was necessarily abandoned for a time, and an effort was made to supply the deficiency with a domestic product, with such good results that at present few foreign-prepared Russian sardines enter into the United States trade.

The present method of preparation is as follows:

As soon as practicable after being removed from the water the fish are placed in strong brine contained in suitable casks. It is desirable that this be done while the fish are yet alive, so as to remove any possibility of putrefaction starting in. There they remain for about ten days, depending on the size of the fish and state of the weather, or until thoroughly struck. The fish are then scaled, beheaded, eviscerated, and cleansed in clear water, after which they are placed on sieves or other suitable receptacles for draining. After draining for several hours the fish are spread upon packing tables and assorted according to their size, each size being packed separately in kegs, with a mixture of certain preservatives combined with flavoring substances. The preservative substances are vinegar, allspice, and chile pepper, or their equivalents. The flavoring substances are sliced

onions, bay leaves, horse-radish, cloves, ginger, coriander seed, and capers or their equivalents. When all are used, the following (according to Mr. Henry Sellman) is about the usual proportion for every 120 pounds of fish: Vinegar, 2 gallons; allspice, 1½ pounds; sliced onions, 4 pounds; sliced horse-radish, 2 pounds; bay leaves, 1 pound; cloves, ½ pound; ginger, ½ pound; chile pepper, ½ pound; coriander seed, ½ pound; capers, 2½ ounces.

The fish are packed in kegs of uniform size, containing about 7 pounds. A small quantity of vinegar and a thin layer of the other ingredients are placed in the bottom of the keg, and a layer of fish, placed back upward, are put in and gently pressed down. Another small quantity of vinegar and thin layer of the other ingredients are then put in and another layer of fish, and so on until the keg is full, when a small quantity of vinegar is poured over the whole and the keg headed up. In order that the fish may be well flavored they should be prepared some days before being placed on the market. This length of time varies, according to the temperature, from about four days in summer to three or four weeks in winter. When properly prepared the fish will readily keep a year or longer without spoiling.

The preparation of herring in this manner was begun at Eastport, Maine, in 1874, and since then has been confined to the eastern portion of that State. Later it was found convenient to simply salt and dress the herring at Eastport and ship them in barrels to New York City dealers, who pack them in kegs for the market, and this is the way in which the business is generally conducted at present.

The fish are either shipped in the barrel in which they are being salted, or, as is more commonly the case, they are packed in shipping barrels after being dressed. In packing, each layer of fish is sprinkled with dry salt. On arrival in New York City they are subjected to the same treatment described above. The quantity of Russian sardines prepared annually in this country amounts to about 60,000 7-pound kegs, worth about $27,000.

The following is a popular method of preparing these herring on the shores of the Baltic Sea in Norway:

The fish are placed in vinegar weakened by the addition of 25 per cent of water, and to which a particle of salt has been added. In this bath the fish remain for about 24 hours, when they are removed and the vinegar drained off. Some persons place the fish for 12 hours in vinegar which has not been weakened with water, the important point being that they must be taken out before the skin becomes flabby. The fish are then carefully packed in kegs or jars with the following preservatives and spices, the quantities given being sufficient for 80 herring: Fine salt, 1 pound; powdered sugar or sometimes brown sugar, 1 pound; black pepper, ½ ounce; bay leaves, ½ ounce; saltpeter, ½ ounce; sandal, ¼ ounce; cloves, ⅛ ounce; ginger, ⅛ ounce; Spanish hops, ⅛ ounce. Others use the following spices: Salt, 1 pound; sugar, ½ pound; allspice, 1 ounce; pepper, 1 ounce; cloves, ½ ounce; Spanish hops, ½ ounce. In this mixture the herring should be left for at least two months before using, and if the brine should leak off, additional brine made of Lüneburg salt should be added; and under favorable conditions the product will keep for years.

CHRISTIANIA ANCHOVIES, ETC.

In the preparation of Christiania anchovies many methods and flavoring ingredients are used, depending on the skill and ideas of the curer and the markets for which the preparation is intended. The following is one of the most popular processes:

The fresh sprat or anchovies are immersed in brine for 12 or 18 hours, 15 pounds of Liverpool salt being used for each 100 pounds of fish. On removal, the fish are drained in a sieve and then loosely packed in a barrel, with the following ingredients, which have previously been finely crushed and well mixed: 4 pounds of Lüneburg salt, 6 units of pepper, 6 units of sugar, 6 units of English spices, 1 unit of cloves, 1 unit of nutmeg, and 1 unit of Spanish pepper. The anchovies remain saturated with these ingredients for 2 weeks, when they are repacked tightly in kegs or barrels, being carefully arranged in layers, with the backs downward. A quantity of the ingredients above

mentioned is sprinkled over each layer, with the addition of a few cut bay leaves or cherry leaves. At the bottom and the top of the package is placed two whole bay leaves, but before the top leaves are laid on, brine is poured over the fish. The barrels or kegs are then coopered and rotated daily for the first few days, and after that every other day for two or three weeks.

The following process is also used to some extent:

The fish are salted for 24 hours and next immersed in sweetened water, 20 parts of water to 1 part of sugar being used. The fish are then packed with a mixture of Lüneburg salt with 90 units or parts of allspice, 60 units of pulverized sugar, 19 units of whole peppers, 15 units of cloves, an equal quantity of nutmeg or mace and of hops (*Origanum creticum*), and some bay leaves.

The following is a choice method of preparing "Mätjeshering" in Germany:

Fresh full herring, both spawners and melters, are well washed, and the gills, stomach, and intestines are removed in such a way as not to necessitate cutting the throat or abdomen, this being accomplished by pulling them through the gill flap. The fish are next immersed for 12 or 18 hours in a 7 per cent solution of white-wine vinegar, from which they must be removed before the skin becomes flabby and be wiped dry and covered with a preparation composed of 2 pounds of salt, 1 pound of powdered sugar, and a small quantity of saltpeter, this quantity being sufficient for 75 herring. The fish are then packed in a barrel as upright as possible, in layers, with a sprinkling of salt over each. The following day the fish are returned with the original brine to the barrel, which is sealed. When there is not sufficient brine to fill the barrel, additional should be made of 1 part of the above mixture and 4 parts of water which has been boiled.

Spiced herring (*Gewürzhering*) are prepared in Germany in the manner above described, with the addition of spices mixed with the salt. The spices commonly used consist of 1 part of Spanish pepper, 5 parts of white pepper, 4 parts of cloves, $2\frac{1}{2}$ parts of ginger, an equal quantity of mustard, and a particle of mace and of Spanish marjoram, with a few bay leaves scattered between the layers.

PICKLED STURGEON.

In the early history of New England pickled sturgeon was an article of home traffic, and considerable quantities of it were exported to the West Indies. During the early half of the present century comparatively little use was made of sturgeon, either fresh or otherwise, but since 1860 there has developed a considerable demand for the flesh, especially when smoked.

A small quantity of sturgeon is brine-salted along the Southern coast and on the Great Lakes in the manner described for swordfish, but the smokers take nearly all the surplus from the fresh-fish market.

It is probable that the pickled sturgeon referred to in the early New England history was prepared in practically the same manner as is still in vogue among the Germans in the West, i. e., by boiling the meat and preserving it in weak vinegar flavored with suitable spices.

In 1629 Governor Endicott, of the Massachusetts Colony, was "ordered to send home to the company in London two or three hundred firkins of sturgeon and other fish"; and by 1633 a considerable export trade existed in pickled sturgeon, most of which were caught in the Merrimac River. An early description of the town of Newburyport, Mass., says: "At the mouth of the river stands Newbury, pleasantly situated, where abundance of sturgeon are taken, and pickled after the manner used in the Baltick." The Indians called that river Monomack, signifying sturgeon. In 1656, "a keg of sturgeon, ten shillings," was among the charges for entertaining an ecclesiastical council at Salisbury.

In 1680 the court licensed Thomas Rogers "to make sturgeon, provided he shall present the court a bowl of good sturgeon every Michaelmas court." The business was quite extensively carried on along the Merrimac River as late as 1733, and quite a large trade was established with England and the West Indies. They sold for 10 or 12 shillings per keg, and one sale is recorded of "15 kegs of sturgeon for a small cask of rum and a cask of molasses."

The general court of Massachusetts, at Boston May 7, 1673, was petitioned by William Thomas for protection in putting up sturgeon. The petitioner stated:

After sundry experiments and travels into forreigne countries upon great expense to his estate hath through ye blessing of God upou his industry therein, attained unto the act of boyling and pickling of sturgeon by means whereof it is a commodity not only in this country but in England and other parts for transportation and purposes of traffic for the procuring of goods more useful and needful to this country. (Massachusetts Maritime Manuscripts, II, p. 3.)

At the same session of the general court the following law was enacted:

Forasmuch as sundry unskilfull persons have of late yeares taken upon them to boyle, pickle, & sell sturgeon for transportation, of which sundry keggs & other caske have prooved corrupt & wholly unserviceable, to the disappointment & damage of sundry merchants & others, as also to the debasement of that comodity, & reproach of the country, wch, if duely ordered, might be beneficiall to the inhabitants for transportation & otherwise, it is therefore ordered & enacted by the authority of this Court, and be it hereby ordered & enacted, that no person whatsoever shall henceforth boyle, pickle, or packe up any sturgeon for sale in this jurisdiction but such as shall be licensed thereunto by the County Court where such persons inhabit, on poenalty of forfeiture thereof, one halfe to the informer, and the other halfe to the county. And to the end there may be no fraud or abuse in the said comodity, every such licensed person shall brand marke all caske wherein it is packed wth the letters of his name; and that there be searchers appointed & sworne to view all sturgeon made heere, or imported, before it be sold or in kinde passed away, who shall sett their marke on such as they finde sound & sufficient in all respects, both as to the quallity of the sturgeon & gage of the caske; and that only such so marked as above shall be exported, on penalty of forfeiture of the whole value thereof; ffor whose care & labour the sturgeon boyler or importer shall pay, for the veiwing & heading thereof, after three shillings fower pence per score for all kegs & firkins, from time to time. And if any shall counterfeit the sturgeon boylers or packers marke, they or he shall forfeit five pounds to the country for every such defect. And it is referred to the respective County Courts to license able & fitt persons to boyle & pickle sturgeon for sale, as likewise to appoint searchers to view & marke the same as aforesaid. (Records of Massachusetts, vol. IV, part II, page 553.)

PICKLED EELS.

Notwithstanding the abundance of eels in the United States, comparatively few are marketed except in a fresh condition, and even the demand in the fresh-fish markets is rather small in many localities, owing to their snake-like appearance. In New York City and a few other points some are pickled, and at various places they are smoked to a small extent. In Europe there are a number of valuable eel fisheries, the most celebrated of which is that of Commachio, near Venice, where pickled eels are prepared in large quantities, as follows:

The fresh eels are dressed and well cleansed with a brush; they are placed in salt brine for 2 or 3 hours, and on removal are dried thoroughly with a towel, cut in pieces of suitable length, immersed in Provence oil, and cooked in a frying pan. On the cooking being completed, the eels are removed from the oil and allowed to cool upon blotting paper, and to the oil in the pan are added some white peppercorns, whole mace, bay leaves and lemon, and a quantity of weakened vinegar, this mixture being cooked for 15 or 20 minutes. The pieces of eel are laid in glass jars or stone jugs, and over them is poured the above mixture after it has cooled, the quantity of which must be sufficient to cover all the pieces and half an inch more. The jars are then carefully sealed and put away in a cool place.

Another method of pickling eels is the following:

The dressed eels are sprinkled with salt, which is soon rubbed or wiped off; then the eels, cut in pieces of suitable length, are spread with butter and broiled brown upon a gridiron. The pieces are next placed in suitable receptacles, such as jars, kegs, etc., and among them is spread a mixture of bay leaves, whole cloves, pepper, English spices, and a little mace. A weight is placed on the eels to keep them compressed and the receptacle covered. After 24 hours the weight is removed, vinegar added to cover the pieces, and the receptacle tightly sealed.

PICKLED SALMON, ETC.

The following description of an old method of pickling salmon, in use in northern Europe to some extent at the present time, is from "A treatise on fishing for herrings, cod, and salmon, and of curing and preserving them," published in Dublin in 1800:

As soon as the salmon is caught they cut off the jowl, which they split into two parts, and cut the rest of it (as far down as below the anus) into pieces about 3 inches thick. The tail may be left long at pleasure. All these pieces are put into a large vessel full of fresh water, in which they are washed with care; the water is changed three times, so as to take out all the blood. Each piece is fastened separately to small laths, to prevent their touching one another. They then boil, apart, as much water as may serve to cover all the fish, to which they add two bottles of Rhenish wine, a bottle of good vinegar, some mace, cloves, pepper in grain, or long Portuguese pepper, coriander seed, thyme, leaves of laurel, a clove of garlic, and more or less salt, according as they intend that the salmon should keep for a longer or shorter time. When this water boils they put the pieces of salmon into it, placing the jowls uppermost, as they boil sooner than the rest, and when the whole is boiled they take it out and let it drip on a linen cloth. When the water has cooled they pass it through a searce, or sieve; then they put the salmon, in pieces, into an earthen jar or pot, upon a bed of leaves of laurel, and throw between the pieces a little salt and some slices of lemon. They then pour upon it the sauce in which the salmon was boiled, until it is quite covered, and fill up the vessel with the jowls and tails; after which they pour good oil upon it and close the vessel. Salmon prepared in this manner will keep a considerable time.

Among the proprietary compositions for preserving fish in vinegar, spices, etc., was one patented* in 1881 by Paul Brick, of Cape Elizabeth, Me. This method was intended particularly for mackerel, but it is claimed to be equally applicable to other species of fresh fish. Brick's process is as follows:

The fish after being scaled and dressed are cut into pieces of about 2 inches in length, cleansed and placed for about 12 hours in a cold sauce of pickle made of 1 gallon of strong cider vinegar, one-half ounce of green parsley, eight bay leaves, 4 ounces of onions, one-half pound of salt, and 1 ounce of the following spices mixed in equal parts: Mustard seed, cloves, allspice, mace, cinnamon, and pepper. At the end of 12 hours the fish are removed from this pickle and placed in air-tight pots or jars with another sauce or pickle composed of similar ingredients to the first and in the same proportion, and to which have been added 1 gill of capers, a half-pint of olive oil, 1 gill of Worcester sauce, 2 lemons, and a small quantity of extract of anchovy, and allowed to simmer for 5 or 6 hours at a temperature of about 140° F., when the jars are sealed.

From *Bayerische Fischerei-Zeitung*, No. 30, Munich, 1885, is taken the following method of pickling fish, applicable to sturgeon, salmon, and other large species:

The fish is cut into pieces, strongly salted down, fried rather quickly in butter and oil, then laid upon a plate, each piece by itself. Before the pieces have cooled off they are put in layers in a porcelain or glass vessel, with some "tan liquor" (beize). This covers all the pieces. To 1 kilo of fish a sauce is made from 3 deca of the finest olive oil and finely sliced onions. This is cooked until the onions turn yellow. To this is then added heated strong vinegar, whole spices (white pepper, cloves, and Jamaica pepper), a few bay leaves, and shalot. All this is cooked together and then put away to cool. Enough vinegar is used to make sufficient pickle and also to cover well the pieces of

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* See Letters Patent No. 241187, dated May 10, 1881.

fish. The vessel has either a tight cover or it is tied up with paper. When some of the pieces are taken out and there is not enough "tan liquor" in the vessel to cover the remaining pieces, either some more of this liquor is added or a sufficient amount of vinegar is used.

With a view to softening the bones of small pickled fish so that they may be freely masticated, a method was introduced about thirty years ago in which the dressed fish are placed in a suitable receptacle with a mixture of vinegar, salt, cloves, and cayenne pepper. The receptacle is then closed and the contents subjected to a temperature of about 170° F. for 24 hours.* The acid of the vinegar neutralizes or dissolves the phosphate of lime and the heat serves to reduce the coherence of the particles of animal matter contained in the bones, so that the latter may be masticated and swallowed without inconvenience. This process was used to a limited extent only and is no longer in vogue.

PICKLED OYSTERS.

In pickling oysters, clams, mussels, etc., the mollusks are usually cooked a short period either before or after removal from the shell, cooled, and placed in glass jars or other receptacles with vinegar, spices, etc., according to the ideas of the preparer.

A generation or two ago large quantities of pickled oysters were put up for use in and about New York City, the consumption being especially large during the Christmas holidays; but their popularity has greatly decreased, and during recent years probably not over 50,000 have been pickled annually, mostly in New York City, to fill special orders. The choicest oysters are generally used. The process is as follows:

The raw oysters are removed from the shells in the usual manner, as much as practicable of the liquor being saved. The oysters, with their liquor, are boiled in an open kettle for 5 to 30 minutes, according to the length of time that will elapse before they are to be used. It is important that the boiling be reduced as much as practicable for good keeping, since the longer they are boiled the smaller and harder they become and the more difficult to flavor. When boiled sufficiently the oysters and liquor are separated, the former spread on shelves to cool and the latter strained and mixed with sufficient vinegar to impart the flavor desired, to which may be added mace, lemon, and other flavoring ingredients, if desired. When both the oysters and liquor are quite cool, they are combined and sealed up in glass jars or other suitable receptacles and stored in a cool place. If the cooling of the oysters and liquor after boiling be not done separately, the oysters become soft and disintegrate, affecting both the appearance and keeping qualities.

An objection to the above method of pickling is that when the oysters are cooked they become shriveled and somewhat unsightly, and if merely scalded the vinegar soon acts upon the tissues, rendering them soft and equally unsightly.

In 1879 the following process of preparing "jellied oysters" was patented † by Katherine L. Jewell, of New York:

A quantity of freshly opened oysters are slightly cooked so as to plump them. They are immediately placed in the vessel in which they are to be marketed and covered with a liquid prepared in the following manner: A suitable quantity of oyster liquor containing a few fresh oysters is boiled until the liquor is so far inspissated as to form a jelly (solidify) when cooled. This liquor is strained and while warm is mixed with its weight of heated vinegar, to which spices are added to suit the taste. This liquor is poured over the plumped oysters so as to cover them, and it will, when cooled, form a jelly sufficiently firm to support the oysters and form with them a semisolid mass impervious to air.

The small oyster crabs (*Pinnotheres ostreum*) found at times in the oysters are sometimes pickled at Chesapeake ports in a manner similar to that applied to oysters, but they are so scarce and the price for them fresh is so high that the quantity pickled is very small.

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* Letters Patent No. 70435, November 5, 1867. † Letters Patent No. 215628, May 20, 1879.

PICKLED CLAMS, MUSSELS, SCALLOPS, ETC.

The process of pickling clams, mussels, and scallops is quite similar to that employed in preserving oysters, differing principally in the manner of removal from the shell and in cooking. The trade in these products is very limited and is centered about New York City.

Clams or quahogs are generally steamed in the shell, a basketful being placed in the steam box at a time, where they remain for 10 to 30 minutes, according to the time for which they are to be kept. On removal the clams and liquor are cooled separately, the latter being first strained and flavored with vinegar, lemon, mace, etc., and then combined and sealed up in suitable receptacles. The object in steaming the clams is to avoid cutting and bruising the meats, which would result if they were opened raw.

The shells of mussels are usually covered with dirt, which should be thoroughly rinsed off. The mollusks are then generally scalded in brackish water in the shell for 10 or 15 minutes and on removal therefrom the dark filament or beard is pulled off, when the meats and liquor are cooled separately and treated similarly to the process of pickling oysters or clams, the flavoring ingredients being selected according to the individual fancies, but consisting usually of mace and cloves in addition to vinegar.

The quantity of ingredients suitable for 100 mussels is about a pint of white vinegar, an ounce of mixed cloves and allspice, with a large red pepper and a few blades of mace. These should be boiled with the liquor from the mussels, and when cooled the whole is poured over the meats. The quantity of vinegar used is small, only sufficient for flavoring. While almost any vinegar might be used, white wine or cider vinegar is preferred. Pickled mussels should be kept in a cool, dark place, for if not well excluded from the light they will turn dark.

PICKLED LOBSTERS.

When a lobster dealer is overstocked with boiled lobsters or with lobsters so weak that they must be boiled to save them, or less frequently when a fisherman desires to dispose of short lobsters caught contrary to local regulations, the usual method is to pickle them. For this purpose the live lobsters are first boiled and the meats extracted, 100 pounds of round lobsters yielding about 25 pounds of meat. The meat in the tail and the large part of the claw is the only portion used, that in the knuckle being discarded, since the quantity is so small that it does not pay for the work of removing it. One man can usually pick out 100 pounds of meat in three hours. The meat is immersed in vinegar for two or three days, then replaced in fresh vinegar and placed in suitable packages, which are usually glass jars with cork stoppers when prepared by the dealers, and barrels, kegs, or stone jars when the pickling is done by the fishermen. White-wine vinegar is preferred to cider vinegar, since the latter has a tendency to make the meat dark, and the vinegar may be weakened to suit the taste desired unless it is proposed to keep the lobsters a long time. If carefully protected in tight packages, the pickled meat will keep several months under ordinary conditions. It sells for about 12 or 15 cents per pound, representing an equivalent of 2 or 3 cents per pound for the live lobsters.

PRESERVATION OF FISHERY PRODUCTS BY SMOKING.

Fish and other food products have been preserved by smoking from time immemorial. The process was well known in Europe during the fourteenth century, and it appears to be used by savage tribes of many different localities. It consists in exposing the articles fresh or, as is more frequently the case, slightly salted, to the action of smoke produced by smoldering wood, bark, or sawdust. Its efficiency depends upon the drying as well as the action upon the texture of the fish of the pyroligneous acid produced by the smoldering, which at the same time imparts an agreeable flavor to the product. Smoking is practiced to some extent by nearly all nations, especially in curing oily species of fish, such as herring, haddock, halibut, salmon, etc.

In the United States smoked fish are cured either round, eviscerated, split and beheaded, or cut into small pieces with or without the skin removed, according to the species. Small sea herring, cured as hard herring, and bückling, alewives, fresh mackerel, etc., are usually not dressed at all; bloater herring, lake herring, eels, salt mackerel, flounders, etc., are usually split down the belly to the vent and eviscerated; salmon and haddock are usually split so as to lay out flat like dried codfish, and halibut, sturgeon, and sometimes catfish, are cut up into small pieces before smoking.

After being dressed the fish are at once struck with salt, the length of the salting differing according to the species being prepared, but ranging from an hour or two to a week or more, and in case of halibut, salmon, mackerel, etc., they may be smoked after being salted a year or two, the excess of salt being removed by soaking in water. On removal from the pickle the fish are cleansed and attached to smoking-sticks and after drying for a few hours are placed in the smokehouse, or, in case of halibut, they may be dried on cod flakes for a day or so and then strung on sticks and placed in the smokehouse. All fish cure better and present a neater appearance when cured, if dried in the open air a few hours before being placed in the smokehouse.

Both cold-smoking and hot-smoking are employed, the result of these two processes being quite different. In the former, the fish are suspended at a distance from the fire and smoked at a temperature less than 80° F.; in the latter process the fish are partly or entirely cooked while smoking, being hung near the fire. In cold-smoking the exposure may be only a few hours, as in the case of salmon, or it may continue for weeks, as in curing hard herring, the length of exposure depending on the article prepared and the time that will probably elapse before it is consumed, whereas hot-smoking is always completed within a few hours, usually within three or four. Cold-smoking is used principally in the United States, England, Norway, Holland, Russia, and Scotland. It is applied to herring, alewives, halibut, haddock, salmon, salt mackerel, flounders, butter-fish, etc. In Germany and Sweden hot-smoking is the more important, but it is not extensively employed in the United States, being confined mainly to New York, Chicago, Milwaukee, and other centers of foreign population, the species so treated being sturgeon, lake herring, whitefish, eels, catfish, fresh mackerel, etc.

HOGSHEAD SMOKEHOUSES AT WASHINGTON, D. C. FISH SUSPENDED ABOVE HOGSHEADS FOR THE PURPOSE OF COOLING AFTER SMOKING.

The style of the smokehouse depends on the particular product for which it is intended. The large houses used for smoking herring, halibut, and Finnan haddie are described in the paragraphs relating to the preparation of those respective products. The houses for smoking sturgeon, lake herring, eels, etc., are generally much smaller. Three or four smoking chambers are usually ranged side by side and are commonly built of brick with 8-inch walls with a ceiling of tin or zinc. The height ranges from 6 to 14 feet, inside measurement, the width 3½ to 5 feet, and the depth or length 6 to 12 feet. In most cases provision is made for smoking only three rows of fish, the lowest of which is from 3½ to 6½ feet above the floor, and the others at intervals of 13 to 18 inches above that, the uppermost one being from 8 to 18 inches below the ceiling, so that the fish will be removed somewhat from the body of hot air which accumulates at the top. In the ceiling there are eight or ten small holes, an inch or so in diameter, leading to the flue or chimney.

Most of the houses are of the larger size above given, and when smaller sizes are used it is sometimes necessary to protect the fish from the heat, or they are liable to become too hot. This may be done by placing two small stands of bricks, about 14 inches high, on the floor and building the fire between these, and when necessary to protect the fish from the heat a metallic pan is placed over the fire, the ends resting on the brick piles. In places where the smoking is of small extent the houses are generally cheaply constructed, and some curers do their smoking in an old dry-goods box, the top of which is covered with boards, mats, or sacking. The fish are placed on sticks, and these are placed crosswise inside the box. This is suitable only for hot-smoking, and to adapt the box to cold-smoking the smoke is admitted to the box at its lower end through a trough or channel of boards. Years ago the old-fashioned open kitchen chimneys were used for hot-smoking by arranging the sticks of fish 3 or 4 feet above the fireplace. This form of chimney is being gradually discarded, but a few are still used in smoking fish for home consumption.

The hogshead smokehouses used in a few localities for hot-smoking sturgeon, eels, herring, etc., are quickly and cheaply constructed and well adapted to the purpose. An old sugar or molasses hogshead, with the head removed, is placed on end on the ground, 2 or 3 bushels of earth being first removed so as to form a pit for the fire. For convenience in placing the fuel and in making the fire, 12 or 14 inches of the lower end of one or two of the staves are removed. Across the top of the hogshead in the middle is an iron rod or a piece of old gas-pipe, on which rests one end of the smokesticks containing the fish, the other end of the sticks resting on the chime of the hogshead. After the fires are built and the fish placed in the hogshead, the latter is covered with old sacking, such as discarded salt sacks, to confine the smoke. The capacity of each of these hogshead smokehouses is 200 pounds of fish at one time. They are intended especially for hot-smoking, and a mixture of oak and hickory wood is used for fuel. Usually two or three hogsheads are ranged side by side, and for protection against the weather they should be inclosed within a shed or house.

The foreign smokehouses are quite similar to our own. The following is a description of two, the first being situated at Masnedsund, and the other on the island of Bornholm, in Denmark:

The oven, with the fireplace below, is 6 feet broad, 5½ feet high, and 3 feet deep. In front there are iron doors. There is room in the oven for three rows of poles; the distance from the fire to the lowest row is 3½ feet, and the distance between the rows 14 inches. At the top the oven can be closed by a lid, which opens outside, toward the back wall of the chimney. The chimney projects about a

foot beyond the front of the oven, and therefore forms an opening for the escape of the superfluous smoke. The oven is about 6 feet high, and grows narrower toward the top, which is about 1 foot in diameter. The chimney is held together by a strong iron bar. When the fish have been dried in the air, smoking may be done on all three irons, therefore in three rows. The lid at the top is then kept closed. If, however, the oven is to be used for drying, the two upper rows are used for this purpose, and in that case the lid must remain open, and the opening is covered by bags or pieces of board. Gradually, as the two lower rows have been smoked, the two upper ones are put a row farther down, and a new row is hung on the upper iron.

A larger smokehouse in Svanike, on the island of Bornholm, is about 18 yards square and 4 yards high, while the chimney is 6 feet high and 4 feet broad. There are seven smoke rooms, or ovens, for hot-smoking, and one for cold-smoking. The herring are hung in pairs over poles 3 feet long, one herring's head being stuck through the gills of the other and coming out at the mouth. If necessary, a thin stick of wood serves as a skewer. On each pole about 40 herring can be hung, which must not touch each other. The poles are arranged crosswise over square frames, 3 feet broad and 7 feet long, which are run into the oven on ledges. Each frame contains 26 poles, and about 1,040 herring can be smoked in it at the same time. The entire smokehouse can contain 22,400 herring, which are smoked by the hot method. The lowest frame is about 3 feet above the fireplace. In the cold-smoke chimney about 12,000 herring can be smoked.

A few smokehouses, which are devoted principally to smoking river herring or alewives, are constructed with the fire-box outside of the house containing the fish, to avoid heating or burning the fish and to more carefully regulate the smoking. One of these is constructed as follows:

A foundation is made of brick, 9 feet square, 2 feet deep, and 12 inches thick, on which rest brick walls 8 inches thick and 15 feet high on the rear or furnace side, and 16 feet on the front or entrance side, giving the roof a pitch of one foot in eight. About 9 feet from the floor there is set into the walls, on the inside, a ledge of iron, on the front as well as on the rear wall, on which rest pieces of scantling for holding the herring sticks. These are followed by other ledges 12 inches apart until within a few inches of the top of the rear wall. The house is ventilated by a door in the roof, 12 by 15 inches in area, which may be opened or closed by means of a long rod. The furnaces are constructed in the rear of, and adjacent to, the smokehouse, and are 3 feet high, the end and division walls 4½ inches thick, the four grates 20 inches wide and 28 inches deep, and the doors of cast iron 11 by 12 inches in area. The smoke generated passes into four inclined flues, 8 inches square, connecting with the smoke or fish room. These smoke flues are 6 feet long and project two-thirds across the width of the house. In the top of each there are two openings which may be stopped with caps when but little smoke is needed, or each may be covered with a smoke spreader, which consists of a circular piece of tin or iron supported by wires attached to a rim made to fit the openings, and is 12 or 15 inches in diameter and set about 18 inches above the tin to which it is attached. In such a building 5,000 river herring may be smoked in 3 days.

The material which is used for producing the smoke consists of some hard wood or hard-wood sawdust. Oak or hickory mixed with sawdust is the most common in this country, but a variety of other woods are used, depending on the facilities for obtaining it as well as its suitableness for the purpose. In the extensive herring smokehouses at Eastport, Maine, white birch is generally preferred, but driftwood which has been soaked with salt water is used to a considerable extent. At Gloucester and Boston ship carpenter's chips of oak or oak edgings, with sawdust to smother the flames, are used principally. In New York City mahogany and cedar sawdust are used extensively, and at Buffalo maple wood is used exclusively. At Sandusky and Detroit the smokers use hickory wood and sawdust. Shavings and sawdust of pine wood are not very desirable, as they are apt to impart a resinous flavor to the fish. Dry chips of oak are used in Holland, and when those are not readily obtained, poplar, birch, or ash are used. In Denmark the fuel used is alder wood slightly moistened so as to make more smoke, and oak and beech sawdust is used to keep the flames

down when they blaze up too high. The smokehouse should always be warm and dry before the fish are put in, as the development of steam is apt to injure the fish. Even when using the same kind of wood, the length of time required to smoke an article of uniform grade depends largely on the condition of the weather, much longer time being required when the weather is sultry than when it is clear and windy.

The length of time that smoked fish will keep depends on the extent of the salting and smoking, and on temperature conditions. Hard herring will keep for a year or more; smoked halibut and haddock will keep only a few weeks, and those products smoked only a few hours are not likely to keep more than a week or so. If the weather be cold and dry, smoked fish keep very much longer than when it is sultry. Some curers, especially halibut smokers, prevent a liability to mold by sprinkling a small quantity of fine dry salt over the fish after smoking; others use compositions of boracic acid, salicylic acid, and other antiseptics sold under various trade names, but the best preventive is to keep the fish in a cool, dry place and dispose of them as soon as practicable after smoking.

Not content with the somewhat slow process of smoking, some dealers have introduced methods by which they reduce its extent, or else do away with it altogether, thus saving in time and in loss of weight of fish. Their process consists in coating the fish with a form or composition of pyroligneous acid to impart a smoked flavor, and a coloring substance to give the fish the appearance of having been smoked. It is gratifying to know that these devices have not been favorably received in the United States.

For the purpose of preparing a choice product especially for exportation to warm climates, the following process* of treating smoked fish has been introduced, but as yet its application in this country is of small extent:

> The fish, after being smoked, are cooled off and placed in layers in wooden barrels. Between each layer of fish a layer of dry salt is placed in a quantity of about 6 pounds of salt to 100 pounds of fish. The barrels, after having been filled, are kept in a cool place until the fish have become completely hard in consequence of the salt combining with the natural fat of the fish. This process of hardening must take place through the whole body of each fish, and can be ascertained by pressing the fish with the finger, which must leave no recess or impression whatever on the surface of the fish. After the process of hardening has taken place, which will be, according to the sort and size of fish, from within 3 to 15 days, the barrels are filled up with brine and then closed by a cover fitting tightly. The preparation of the brine must be executed carefully in the following manner: Filtered water is boiled with salt to a saturated solution, which latter is allowed to cool off, after which it is skimmed and drawn off as far as it appears fully clear and pure. If the brine is not carefully prepared, as above stated, the fish will not keep for so long a time, which will likewise not be the case if the process of hardening, before described, has not completely taken place. Fish prepared in the mode described will keep for many months and can be sent to hot climates without danger of spoiling. For making such preserved fish eatable it must be taken from the barrel and placed in fresh water to remove its rigidness. This will, according to the size of fish, take place within from 3 to 8 hours, when the salt will be sufficiently removed from the fat. The fish is then dried in the open air and will now fully resemble newly smoked fish. By first taking the fish in their natural condition and smoking them the juices are retained and the fat of the fish is brought to such condition that the salt when applied will readily combine with it and make the fish perfectly hard and solid, especially on the exterior. After the fish are thus smoked and hardened with salt they are brought to a condition in which brine will simply preserve and protect them from atmospheric influences without changing their character in any material way. By thus treating the fish they are preserved without having the entire body of the fish permeated with salt, as after being smoked the dry salt in which they are packed combines chiefly with the fatty substances and forms a hard exterior surface which is not much penetrated by the brine.

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* See Letters Patent No. 352666, dated November 16, 1886.

For use in smoking chunks or portions of large fish, such as sturgeon, previous to canning them, a wire disk-form receptacle, in which the chunks are compressed to a size adapted to the cans in which they are to be placed, is here described:

This receptacle is so arranged that it may be rotated during the smoking process, thus causing the dripping juices to pass through the mass. The product of the usual method of smoking does not remain sufficiently juicy for canning and the irregular chunks require a large amount of oil or other liquid to fill the interstices within the can. The receptacle is drum-shaped, with a cross section equal to the cross section of the can wherein the product is to be packed. It has a movable or inner head and a spring clasp for forcing the head inward, and is so suspended that it may be frequently rotated on the spring clasp. In carrying out this process the sturgeon or other fish is cut up into suitable pieces, salted in brine for the proper length of time, and then neatly placed in the drum until the latter is filled. The head and clasp is then placed in position and the drum suspended in the smoking-room. While subjected to the action of the smoke, and as the fish becomes more and more compact, it assumes the shape of a disk with comparatively flat ends. During the smoking the receptacle is turned from time to time so that the juice that settles at the bottom is frequently brought to the top and again compelled to flow through the mass. These disks may be much thinner than the height of the can in which they are placed, in which case two or three or more are superimposed until the can is filled.*

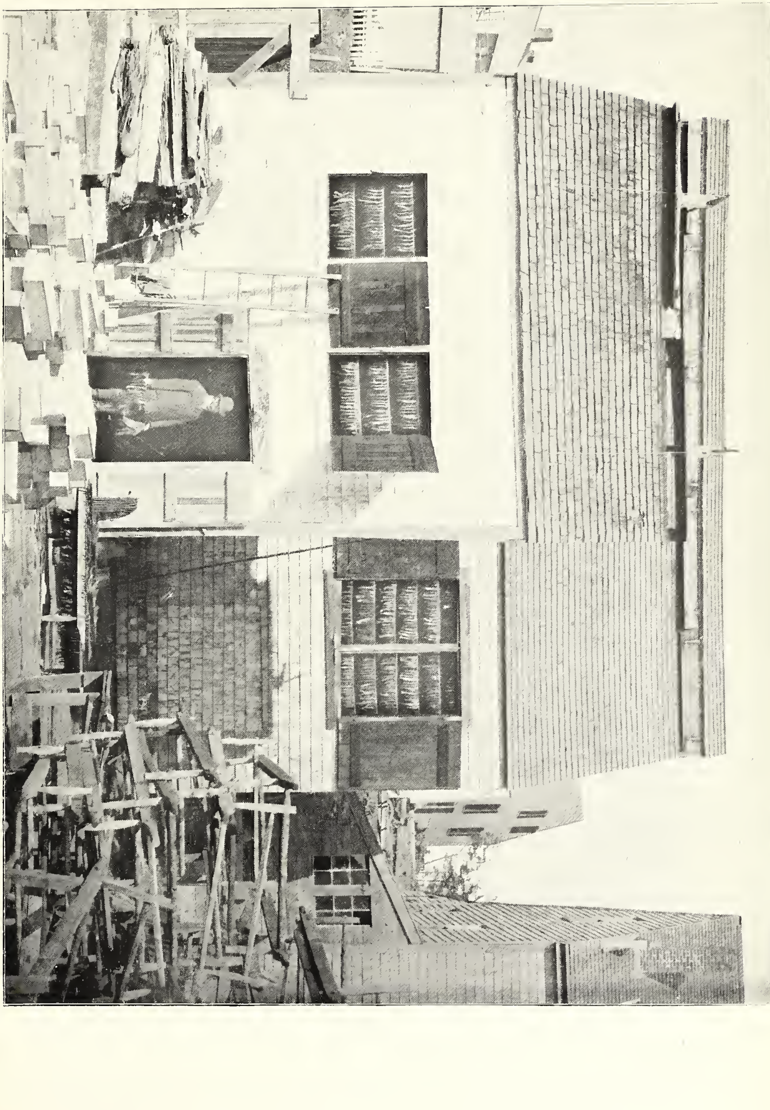
SMOKED HERRING.

The process of smoking is almost as important in the cure of herring as the use of salt in preserving codfish. This was one of the earliest marine products to which smoking was applied, and at present the various species of this family are probably smoked in greater quantities than all other species combined. By varying the process of smoking different products are obtained, almost wholly unlike in appearance, flavor, and keeping qualities, instances of which are the hard or red herring and the bloater herring, both prepared from the sea herring of the New England coast (*Clupea harengus*). The former are smoked three or four weeks, until quite dry, while the latter are exposed to the smoke for only a few hours and will keep but a limited time; the sooner they are eaten the better their flavor. Kippered herring differ from bloater herring principally in that they are split and eviscerated before being smoked. The bückling or pickling prepared in New York City from frozen Newfoundland herring are somewhat similar to the bloaters of Boston, differing principally in that they are smoked at a higher temperature and for a much shorter time. A few Labrador herring pickled in barrels are smoked in New York City, and along the Great Lakes and in the near-by localities quantities of lake herring are smoked. The smoked herring of the Southern States is made from the alewife (*Clupea vernalis*), so abundant in rivers of that region. The methods of smoking applied to each of these various species will be described in detail in the following pages.

HARD HERRING.

The original process of smoking hard herring, or red herring, as practiced in the United States, is said to have been derived from Scotland by way of Digby, Nova Scotia. In 1795 a Scotch fisherman located at the last-named place and devoted his attention to smoking herring as practiced in his native country, the product being sold in Nova Scotia and the adjacent parts of New England under the name of "Digby chickens." Others went into the business and the process gradually extended to the United States, the business being established at Eastport in 1808 and at Lubec in 1812. The trade gradually increased until the beginning of the Washington treaty in 1873, being particularly extensive during the civil war. The average annual output

* See Letters Patent No. 423545, in favor of Max Ams.



HERRING SMOKEHOUSE IN MAINE.

from 1845 to 1872 was not less than 500,000 boxes. The Washington treaty had a very serious effect on the smoked-herring industry, the product in Maine in 1880 being only 370,615 boxes, or 4,434,111 pounds, worth $99,973; whereas importations increased from 1,029,095 pounds, valued at $34,670, in 1874, to 10,441,355 pounds, worth $129,034, in 1885. After the abrogation of the treaty in 1885 the business again reached its former proportions and has been more extensive during the past few years than ever before. The annual product amounts to about 1,300,000 boxes, containing 6,500,000 pounds of cured fish, the wholesale value of which approximates $115,000.

The smoking of hard herring in the United States is confined principally to the State of Maine and to Washington, Hancock, and Knox counties, the business being centered at Eastport and Lubec. The mature *Clupea harengus* is used, taken almost wholly by weirs, the season extending generally from the first of September until late in December. The smoking is done principally by the persons catching the fish, who also depend partly on farming for a livelihood. Usually several of them own a weir in common, dividing the herring equally and preparing them on their separate premises.

The following description of the process of smoking hard herring at Eastport and Lubec is from an account of the industry by Mr. Ansley Hall:*

Description of smokehouses.—The smokehouse is generally only one of a number of buildings used in carrying on the smoked-herring industry. In addition to it there are sheds and shops of various kinds, in which is done a variety of work incidental to the business. There is a shed for pickling and salting herring, a shop in which the smoked-herring boxes are made and where the herring are packed, and there is sometimes a cooper shop for making herring barrels. The buildings are usually located on a wharf or near the shore for convenience in landing the fish from the boats. The frame of the smokehouse is covered with boards and made sufficiently tight to prevent the smoke from escaping. There are board windows in either end and ventilators in the roof. The latter are provided by arranging the boards on either side of the ridgepole so that they can be raised or lowered by means of cords attached to levers. The building is entered by large doors in the end. The value of the smokehouses, including the sheds and equipments, varies from $60 to $3,500 each; for an entire stand of buildings the average value is from about $200 to $500.

In the early days of the industry the smokehouses were very inexpensive, being built of slabs obtained at small cost from the sawmills in the vicinity. A very few of these primitive structures, now almost a century old, are still in use, but in most instances they have been replaced by better ones. As the business increased larger smokehouses were built, in order to make it possible to meet the greater demand for the product. The largest one now in use is at Lubec. The length of the building is 231 feet, 115 feet of which is included in the smokehouse and 116 feet in sheds of various kinds. The width is 25 feet, the length of posts 16 feet, and the height of the ridgepole 29 feet. The smokehouse is divided into three compartments, each having 10 "bays" or spaces in which to hang herring, and its capacity is about 45,000 boxes of medium or 60,000 boxes of large herring. It is as large as three smokehouses of the ordinary size. The smokehouses have no floors, as the area has to be used for the fires. The interior is arranged with a series of vertical rows of 2 by 4 inch scantlings. The spaces between the rows are termed "bays" and are 38 inches in width. The scantlings in each row begin near the ridgepole and extend horizontally crosswise of the building, each one being placed from 13 to 14 inches below the other, to within 6 or 8 feet of the ground. In smokehouses of the average size there are usually 10 "bays," and the capacity is about 15,000 boxes of medium or 20,000 boxes of large herring.

Equipment.—The only equipment used exclusively in a smokehouse are the herring sticks. A large number of these are necessary in the larger houses, as it requires on an average about two sticks to each box of herring. The sticks are prepared at the sawmills in long strips. The size of the sticks as they come from the mill is one-half inch square for medium and five-eighths inch square for large herring. After being cut into lengths of 3 feet 4 inches each, the edges taken off, and one end sharpened they are ready for use. They cost at the rate of about $3 per 1,000 at the mill, and are estimated to be worth from $4 to $5 per 1,000 after being made at the smokehouse.

* "The herring industry of the Passamaquoddy region, Maine," by Ansley Hall, United States Fish Commission Report for 1896, pp. 454–463.

The pickling and salting shed is supplied with wooden tanks for use in pickling the herring. These are from 7 to 8 feet long, 5 feet wide, and 3½ feet deep, having a capacity of about 4 hogsheads, or 20 barrels, of herring each. From 2 to 9 tanks are required in each salting shed. In many instances hogsheads are used instead of tanks. There is also a variety of other utensils, such as tubs, baskets, shovels, and "herring horses." The latter consists of an oblong wooden frame having four legs, the sides extending far enough beyond the end to serve as handles. It is used to hang the herring on to dry after they are strung on the sticks and before putting them into the smokehouse. Its capacity is from 25 to 30 sticks of herring. The cost of the whole outfit for a smokehouse and salting shed varies from $50 to $500. * * *

Herring utilized.—The herring utilized for smoking and salting are derived chiefly from the weirs in Passamaquoddy Bay and its tributary waters. In 1895 the quantity obtained from the American weirs in the bay for these purposes was 5,903 hogsheads, valued at $12,121, and from the Canadian weirs 5,571 hogsheads, which cost $20,036. The average value per hogshead of the former was $2, and of the latter about $3.60. This difference is explained in a measure by the fact that a large part of the American fish was smoked by the fishermen, who carried them to the smokehouses in their own boats, while those from the Canadian weirs were collected at the rate of $1 per hogshead. A considerable quantity of herring was also obtained from other sources. From Machias Bay there were 1,296 hogsheads, costing $4,605; from Grand Manan, 935 hogsheads, $2,323; from the Magdalen Islands, 768 hogsheads, $4,669, and from Newfoundland, 174 hogsheads, $1,740. The total quantity used was 14,647 hogsheads, or 73,235 barrels, the cost of which, landed at the smokehouses, was $45,494. Of these, 12,148 hogsheads, costing $36,215, were smoked and packed in boxes, and 2,499 hogsheads, costing $9,279, were salted in barrels. The herring from Passamaquoddy Bay, Machias Bay, and Grand Manan are received in a fresh condition, while those from the Magdalen Islands and Newfoundland are cured on board the vessels and need no further salting after they arrive at the smokehouses. The Newfoundland herring are used largely in preparing the grade of smoked herring termed "bloaters," but those from the Magdalen Islands do not serve that purpose so well and are generally either packed in barrels as round herring or smoked and packed in regular boxes lengthwise.

Pickling.—When the fresh herring intended for smoking are landed at the salting sheds, they are immediately put into the pickling tanks, which have first been partially filled with a weak pickle. The pickle is made of salt water with about 1½ bushels of Liverpool salt or a smaller quantity of Cadiz or other coarse salt in each tank. The salt is stirred in the water until it is wholly dissolved. If the fish are poor the water is sometimes used without the salt being added. The quantity of fish which is at first put into the tank is generally from 2 to 3 hogsheads, or enough to be of sufficient weight to rest, or, as the fishermen term it, "ground" on the bottom. A light layer of salt, or about one-half bushel, is then distributed over them, after which another layer of fish of from 1 to 2 barrels is put in. This is again covered with a layer of salt rather heavier than the first, being from 1 to 1½ bushels. The remainder of the fish necessary to fill the tank is then put in and covered with from 3 to 5 bushels of salt. Each tank when filled contains 4 hogsheads of fish, and the quantity of salt used on them varies from 6 to 9 bushels, according to their size and fatness and the condition of the weather. It is also necessary to have the greater part of the salt at the top of the tank, so it will not work down through the fish and lodge at the bottom without being dissolved. In that case the fish at the bottom are liable to become too salt and those at the top not salt enough. For smoking purposes the fish are pickled in a round condition as they come from the water. When hogsheads are used instead of tanks the quantity of fish and salt in each layer is regulated to correspond with the capacity of the hogshead.

The small herring are generally allowed to remain submerged in the pickle from 24 to 36 hours, and the larger ones, especially if they are very fat, about 48 hours, and sometimes a longer period. If the herring are small and not fat the length of time required for them to "strike" may not exceed from 12 to 15 hours. Fish will also absorb salt more readily in warm than in cold weather, and if they have been caught a few hours before being salted they do not require so long a time in the pickle as when immediately taken from the water.

When the fish have been properly "struck" or salted, if the weather is fine, so as to afford them an opportunity to dry before being put in the smokehouse, they are taken out of the pickle; but it sometimes happens that the weather is rainy, and they have to remain in pickle much longer than would otherwise be necessary. As a result they become more or less oversalted. In such cases, when favorable weather returns, they are taken out and put in tubs of salt water to be freshened or "soaked out." Newfoundland and Magdalen herring, which are heavily salted on board the vessel when caught, invariably require to be treated in this manner before being smoked. Generally about four tubs of water are used, which are in succession filled with fish. As soon as the last tub is filled the

fish are taken out of the first one and then out of the others in regular order, each tub being at once refilled with other fish, and this process is continued until all the oversalted fish have passed through the water, remaining there only long enough to secure the desired result. If the quantity of fish is large the water in the tubs is changed whenever requisite. It is customary to use salt water for nearly all purposes. The fishermen and smokers claim that fresh water has a tendency to make the gills of the herring tender and more liable to break and allow the fish to fall from the sticks after being hung in the smokehouse. They also think that the salt water makes the flesh of the fish more firm and not so apt to become soft after being smoked. The salting sheds are, therefore, sometimes furnished with steam pumps for obtaining the necessary supply of salt water. * * *

Scaling.—It was formerly customary to remove the scales from the herring intended for smoking purposes before taking them from the boat. The fishermen, with their rubber boots, walked through the mass without lifting their feet, and the contact of the fish with each other and with the legs of the men removed the greater part of the scales. This laborious process was called "treading them out." It is said to have begun in 1820 and was continued until about 1880. Another method of scaling the fish during that period was to stir them with a spudger. In recent years it has not been considered necessary to resort to these or other methods for removing the scales, since the frequent handling which the fish undergo renders them practically scaleless when they reach the smokehouse. The scales of the herring come off very easily when the fish are first taken from the water, but if allowed to dry they become set and are removed with difficulty. The methods for removing them above described insured a more thorough and uniform scaling of the fish than would otherwise be effected, but if the work was not carefully performed it was liable to result in bruising the fish and in an increased loss in "broken-bellied" herring.

Stringing.—When properly salted the fish are taken out of the pickle to be strung on herring sticks preparatory to being hung in the smokehouse. This is done with ordinary dip nets, or "wash nets," as they are called in this locality. As the fish are dipped out they are washed or rinsed in the brine with the nets, after which the pickle is allowed to run off of them and they are laid on the stringing tables. The dipping and stringing proceed simultaneously.

The "stringers," or persons who string the herring, are of both sexes, the females often predominating in number. In some instances the fishermen do the work themselves, but generally men and women and boys and girls are hired for this purpose. The number of stringers employed in each smokehouse varies from 2 to 8 and sometimes more, according to the amount of work to be done. They receive 20 cents per 100 sticks for stringing large herring and bloaters and 25 cents for small herring. The cost of stringing is estimated to average one-half cent per box, but is probably a little less than that. At these prices each stringer can earn from $1 to $2 per day. There are from 25 to 35 herring on each stick, and a person can string from 500 to 1,000 sticks in a day. The work is performed very rapidly. The herring is taken with its back in the palm of the right hand, the stick being held by the blunt end in the left hand; the left gill-cover is then raised by a movement of the right thumb and the pointed end of the stick is inserted and passed through the mouth, the fish being moved down to its proper place. The work is often done by reversing this order, the fish being taken in the left and the stick in the right hand, but in either case the herring when strung hang on the stick with their backs toward the stringer.

Draining and drying.—After the herring have been strung on the sticks they are washed in a trough of clean salt water and hung on the herring horses. They are then carried out into the open air, where they are allowed to remain until the water drains off of them and they have become sufficiently dry to hang in the smokehouse. The time required for drying varies according to the condition of the weather, but is usually from one to several hours. The drying not only hardens the gill-covers and prevents the fish from falling from the sticks in the smokehouse, but also improves their quality when smoked. The work of stringing and drying the herring is generally done in the fore part of the day and in the afternoon they are hung in the smokehouse. If the weather is not fine it is sometimes necessary to dry the fish in the smokehouse after leaving them in the open air long enough for the water to drain from them. When this method is resorted to, the doors and windows are opened to give a free circulation of air and fires are kept burning until the drying is completed.

Filling the smokehouse.—The smokehouse is not usually filled all at one time, and it often happens that the work occupies several weeks. The herring are taken care of as fast as they are obtained from the weirs, the time required to fill the smokehouse depending somewhat on the abundance and constancy of the supply. If the supply is steady, the work progresses as rapidly as herring can be prepared, otherwise the period may be extended to three or four weeks and perhaps longer.

When the herring have been sufficiently dried in the sun they are carried on the herring horses to the smokehouse, where the sticks are placed in the "bays," their ends resting on the scantlings or beams on either side of each "bay." The work of "hanging" the herring requires the services of at least two men, and if a larger number are engaged in it they work in pairs. One man stands in the "bay" with his feet on the beams, while the other stands on the ground or floor and hands the sticks of herring up to him, two at a time, keeping the sharp end of the stick downward so the herring will not slip off. The sticks are made long enough to reach across the "bay" and to nearly the center of the beams which support them at either end.

The lower part of the "bays" is usually filled first. The fires are then kindled and the herring smoked until they acquire a good color. When this is effected the fires are allowed to go down, the doors and ventilators are opened to let out the smoke, and the herring are shifted to a place nearer the top of the smokehouse. The lower part is then ready to receive another lot of fish. This preliminary smoking occupies from about 12 to 15 hours. The work is continued in this manner until the smokehouse is filled. Two smokehouses are very often filled at the same time. In that case, after the top of the house has been filled by shifting the herring, the lower part is completed by putting about three tiers of herring in each house on alternate days. When two houses are filled together, the work can be done in almost as short a time as would be required to fill one alone.

The object of putting the herring into the house by degrees, instead of all at one time, were that practicable, is to insure their becoming thoroughly dry before being subjected to the smoke, and also to smoke them more evenly and secure a greater uniformity of color. If a large body of fish were put into the smokehouse at once they would gather dampness and great difficulty would be met with in preventing them from spoiling. To fill a smokehouse holding 20,000 boxes of herring in a proper manner requires at least two weeks and a somewhat longer period if two such houses are filled at the same time. The length of time also varies according to the size of the smokehouses. Small houses may sometimes be filled in a few days. After the smokehouses have been filled the additional length of time required to complete smoking the herring is about three weeks. Regular herring are placed as close together on the sticks as possible without touching each other, the gill-covers generally keeping them far enough apart. The sticks, when hung, are placed about 3 inches from each other.

Fires and wood.—The fires for smoking the herring are built on the ground at equal distances apart over the entire area of the smokehouse. The wood used is of various kinds, but white birch is generally preferred; driftwood which has been soaked with salt water is also used. The main consideration is to have wood that will burn slowly and produce an abundance of smoke. The fires are kept burning very slowly, the smokehouse being visited every few hours during the night as well as the day. If too much heat is generated the herring are soon damaged and may be completely spoiled.

Previous to 1820, only two brands of smoked herring were known, namely, "number ones" and "number twos." On the introduction of scaled fish, a third brand was added, the "medium-scaled," including all the best fish of medium size that were well scaled. At present there are three principal brands of hard herring, viz, "lengthwise," "medium-scaled," and "No. 1." Another brand known as "tucktails" is also prepared to some extent. The lengthwise herring are the largest of the hard herring prepared, and must be packed lengthwise with the box, hence the name. Of this grade each box contains only about 15 or 20 fish, weighing about 6 pounds, the boxes being of uniform size, 12 inches long, $6\frac{1}{2}$ inches wide, and $2\frac{3}{4}$ inches deep, the thickness of the ends being five-eighths inch, and of the other parts one-fourth inch, the cost of the boxes approximating $15 per 1,000. The tucktails are also longer than the width of the box, but they are packed crosswise of the box, the tails being tucked or bent over them, as indicated by the name. The medium-scaled form the popular size and sell for the highest prices. They are packed crosswise of the box and are usually divided into two sizes, viz, large and small medium herring, 30 to 40 of the former and 40 to 50 of the latter filling a box. The "No. 1" grade is composed of the smallest fish, each box containing from 55 to 75 fish.

Several of the New England States have very extensive and precise regulations affecting the grading, packing, inspecting, and branding of smoked fish, but these

regulations are rarely enforced. In Maine regulations were made from time to time beginning in 1821, affecting the smoking of herring, but in 1871 it was provided—

Hereafter no inspection of smoked herring shall be required, but all smoked herring put up in boxes or casks for sale in this State shall be branded on the cask or box inclosing them with the first letter of the Christian name and the whole of the surname of the person putting up the same, and with the name of the State and the place where such person lives, and all such fish offered for sale or shipping not thus branded shall be forfeited, one-half to the use of the town where the offense is committed, and the other half to the person libeling the same.

Early in the present century the price realized by the fishermen varied from $1 to $1.25 per box, 18 inches long, 9 inches wide, and 7 inches deep, inside measurement. From 1830 to 1850 the average price was about $1.10 for "scaled herring," 80 cents for "number ones," and 35 to 40 cents for "number twos," the size of the box being 17 inches long, 8¼ inches wide, and 6 inches deep, measured on the inside. From that date the price decreased quite rapidly for a number of years, and fish of good quality often sold as low as 7 and 8 cents per box. Later, with the revival of trade, it again improved, until in 1880 it ranged between 12 and 25 cents, according to the quality of the fish, good scaled herring averaging fully 22 cents, while lower grades usually sold at 15 or 16 cents. The boxes in 1880 were usually 15½ inches long, 7½ inches wide, and 4 inches deep, inside measurement. Since 1880 the prices have decreased considerably. In 1894 medium-scaled herring sold for 9 cents, and No. 1 for about 6 cents.

A choice method of packing smoked herring, introduced in 1878, has met with much favor. After the herring have been salted and smoked in the usual way, the skin, head, and viscera are removed and the bones extracted. The flesh is then packed eight to twelve in small wooden boxes with glass fronts or tied in bunches of about one dozen fish each, six of such bunches being packed in a neat wooden box, which also sometimes has a pane of glass introduced in one of the sides to render the contents visible without opening the box. By skinning the herring and placing them together their flesh is brought in close contact, preserving their inherent moisture and flavor, this effect being further increased by packing them in a box. The fish also present a much neater appearance when offered for sale and are more attractive to customers. This process was protected by Letters Patent No. 207980, dated September 10, 1878.

Large quantities of foreign smoked herring are imported into the United States, approximating 4,000,000 pounds annually, worth about $100,000—mostly from Nova Scotia and New Brunswick, though large quantities are received also from Newfoundland, Norway, Great Britain, and the Netherlands. The exports of smoked herring are equal in quantity to the imports, the great bulk of them being sent to Haiti, and smaller quantities to Santo Domingo, Cuba, and other tropical countries.

The following notes on the methods of smoking hard or red herring in Holland and in England are furnished by Mr. Adolph Nielsen:

SMOKING HERRING IN HOLLAND.

The greater part of the herring are caught in the North Sea and salted round on board of the vessel in barrels. After they are brought to the smoking-houses the barrels are opened and the herring put into large vessels to be steeped in fresh water. The length of time in which the herring are steeped depends upon the different markets for which they are prepared. For the local markets, Antwerp and Brussels, they are steeped for two days, while for the Italian markets they are steeped one day, and sometimes not steeped at all, but only washed. In order to liberate the herring as much as possible from scales they are stirred about several times during the day with a stirring pole. The herring which are salted heavy or have remained in salt over the ordinary time are first steeped one

day, then taken up and put in baskets for 12 hours, and after this again steeped another 24 hours. After the herring are sufficiently steeped the water is drawn off and the herring sorted and put in baskets, which contain about half a barrel, and are left in these in the balcony for 18 to 24 hours. The object of this is that the herring, by their own weight, in the baskets, shall press out some of the water, and serve instead of drying, and thereby facilitate the smoking. Subsequently the herring are threaded on willow twigs, as in England, and brought into the smoking-rooms, where they in the meantime, until they can be hung up in the raftwork, are placed on stands made for that purpose. When hung up to be smoked, the fattest, and such herring as are to be smoked strongest, are placed nearest the roof. The fire is made on the floor in a dozen small heaps (according to the size of the room) in each room, and chips of oak are generally used for that purpose if they possibly can be obtained; if not, a mixture of poplar, ash, elm, and birch. Sawdust of oak is applied in order to smother the fire and keep it from flaming, also to form a good body of smoke. After the fire is kindled the small windows close to the roof and the lower part of the door are kept open in order to give a better draft, and also to give the dampness from the herring a chance to escape. The fire is renewed whenever the glowing chips are getting low. When the water after a couple of hours has evaporated from the herring, the small windows close to the roof and the lower part of the door are shut if sufficient draft can be had through the ventilators in the roof. The temperature is kept as near 65° F. as possible and is regulated by opening and closing the small windows and the doors.

Herring prepared for the two principal markets, Antwerp and Brussels, are generally smoked for 12 hours, and supposed to keep good for two weeks. These markets want the herring to be lightly smoked and of a bright bronzed color. Herring prepared for Germany, Italy, and other Belgian parts are smoked for 24 hours, and are supposed to keep good from one month to six weeks. They are dark-colored. After the herring are smoked the small windows and doors are opened and the herring left to cool, either in the smoking-rooms or in the balcony in the raftwork erected there, for a couple of hours before they are packed. The herring are packed in baskets, made of willow twigs, 28 inches long, 17 inches wide at the top, and 12 inches at the bottom, the height about 7 inches, containing 200 each, for the Belgian, German, and home markets; while for the Italian markets boxes and drums made of soft wood are used. The boxes are 21½ inches long, 12 inches high, and 9½ inches wide, and hold about 200 herring. The drums are 20 inches high and 12 inches in diameter and contain from 300 to 400 herring. The herring are packed slantways, back down, across the boxes or baskets, with the exception of the two uppermost layers, which are packed back up. The packing in the drums is just the same as the common packing in barrels. As a rule a little straw is put in the bottom of boxes and baskets. The bowed basket lid is sewed fast by the help of long needle and twine. The herring are sorted for the Belgian and German markets in full and spent, with no regard to size. For the Italian markets they are sorted in large full, medium full, and spent herring. Of the large full it takes about 300, of the medium about 400, and of the spent about 370 to fill a drum of the above-mentioned dimensions. Besides the herring caught in the North Sea and treated and smoked in the manner described, a lot of smaller herring caught in the Zuyder Zee is also smoked for local consumption. These herring are generally brought to the smoking-houses fresh, are pickled in strong pickle for about an hour, left in the baskets to dry a while and smoked for 4 to 8 hours. The smoking of herring for export to foreign countries has not been carried on in Europe to any extent, except in Great Britain and Holland, until of late years, when a lot of this article has also been exported from Norway and Sweden.

SMOKING HERRING IN ENGLAND.

Red herring are for the most part prepared of fresh herring, which are salted dry on the floor in the salting-room connected with the smoking-house, and allowed to remain in the salt 2 to 6 days, according to the length of time they are intended to keep, and according to markets for which they are prepared. After being left a sufficient time in salt they are rinsed in clean water and then threaded on sticks in the same way as the bloaters and hung up in the smoking-rooms, where they are smoked for about 4 weeks. If high dried are wanted, the time of smoking is about 6 weeks. The red herring are smoked with a small fire made of chips of oak and sawdust, and the fire only renewed once every day. The average temperature in the smoking-rooms is kept at about 62° F. Sometimes red herring are prepared from herring which have been pickled in large cisterns. These are soaked in fresh water before they are hung up to be smoked, but otherwise treated in the same manner as the dry-salted red herring. The pickle-salted are called Scotch reds, and are lower in price than the dry-salted herring. Herring which have fallen down or are headless are smoked on the same sticks of wood as the kippers, and are called "red tenters" and "plucks."

In preparing red or hard herring at Yarmouth, England, for the Mediterranean markets, the fish on arrival at the curing-house are, if previously salted on board of the vessels, rinsed to remove the incrusted salt, and then, without other preparation, are again put in salt, that from Liverpool being preferred. After remaining in salt for 10 to 14 days the herring are washed, strung on smoke-sticks, 25 fish to each stick, which is generally about 56 inches long, and placed in the smoke-room, which may be 16 or 18 feet square. A dozen or more fires are made on the floor, the fuel generally being small sticks of oak or ash. The fires are kept burning for two days, when they are permitted to go out and the fish allowed to drip for a day. Then the fires are again lighted for 2 or 3 days, and this process of alternate smoking and draining continued for 2 weeks or even longer, when, after cooling, the fish are ready for packing. For the home market Yarmouth hard herring are packed in flat boxes or in kegs 10 inches high, holding from 80 to 100 fish, and for the Mediterranean markets in barrels and half-barrels. In the latter case, when the barrel is filled to the top, by means of a screw press the fish are pressed down and an additional number placed in, 600 or 700 full-sized fish being the usual number to each barrel.

BLOATER HERRING.

Scotland has always led in the preparation of bloater herring, as in most of the smoked fishery products. It is not known when this article originated, but doubtless as early as the sixteenth century. For two centuries or more it has been an important product in Europe, but it has been prepared in the United States during the last 40 years only. The business is said to have begun at Boston in 1859, as an outgrowth of the importation of large salted herring from Bay of Islands, Newfoundland. The process was similar to that employed in Scotland, and the trade increased until in 1868 10,000 barrels of large herring were smoked and sold as "Yarmouth bloaters." During that year the business was started at Eastport, Me., and on account of the convenience of carrying it on in connection with the extensive smoking of hard herring in the vicinity the trade has largely centered at that port. The preparation of bloaters was begun at Gloucester in 1883, the fish being received salted from Newfoundland, and at present the business at that port is quite large and is carried on principally in connection with the smoking of halibut. Several ports in Maine also prepare quantities of this product, among which are Portland and Lubec. Some are also prepared in New York City.

The Washington treaty in effect from July 1, 1873, to June 30, 1885, had a very disastrous effect on the bloater-herring industry, large quantities being prepared at Grand Manan, Campobello, and other islands in the British North American Provinces, and shipped to Boston and New York. Since the abrogation of that treaty, however, the duty of ½ cent per pound has restricted the preparation of the supply for United States markets almost exclusively to this country. The present annual product approximates 5,500,000 pounds, valued at $170,000 wholesale.

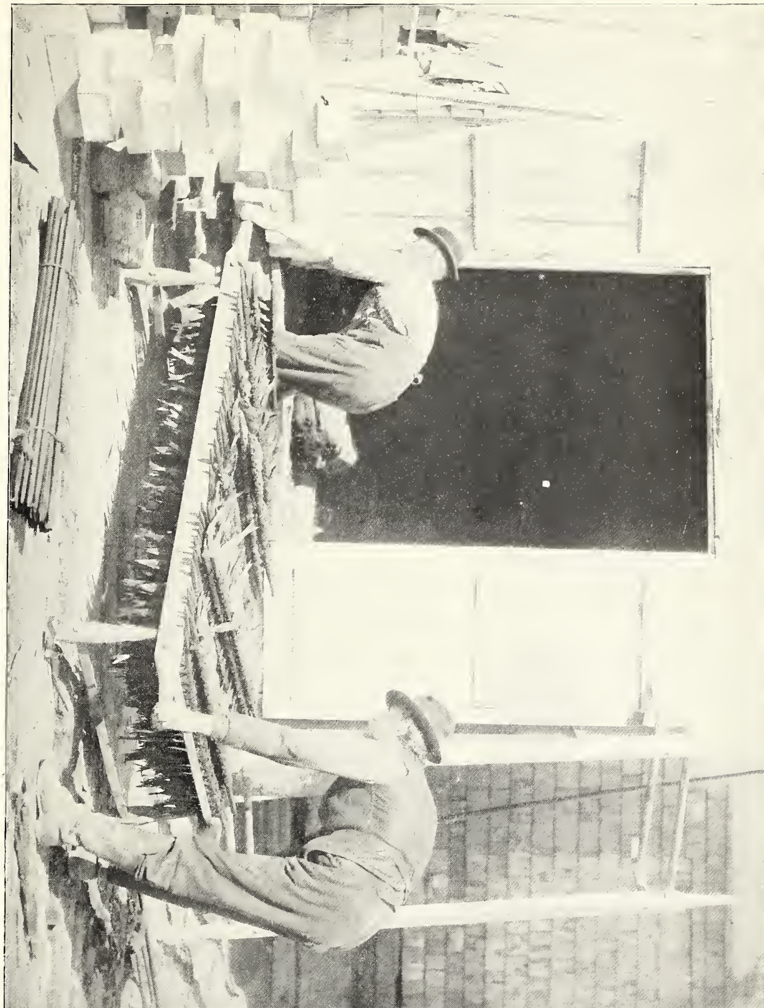
Two general grades of bloater herring are prepared in this country, those from the large Newfoundland salted herring and those from herring caught along the coast of Maine. The business at Gloucester and Boston depends almost exclusively on the salted herring from Newfoundland, while Eastport, Lubec, and Portland use mainly the herring caught on the Maine coast, most of which are received in a fresh state. The Newfoundland herring are obtained from Bay of Islands, Boon Bay, Fortune Bay, Placentia Bay, St. Morris Bay, etc., being purchased of the fishermen at about 60 cents to $1 per barrel, and from 12,000 to 20,000 barrels being imported each year. The

vessels engaged in that trade arrive in Newfoundland during October with from 1,200 to 1,800 bushels of salt each and are moored in some convenient cove. As the fresh herring are landed on deck, a barrel at a time, about $1\frac{1}{2}$ bushels of Trapani salt is spread among them, the mass drudged back and forth several times and then shoveled into the hold in bulk until a cargo is secured amounting to 1,000 or 1,500 barrels. There they remain until the vessel reaches port, the pickle being pumped out when necessary. The fish are then removed and stored in bulk on the floor of the warehouse, where they may remain until the following April if not required in the meantime.

There are two general processes of treating these salted herring preparatory to smoking, the difference being in the manner of soaking. At Boston the salted fish are soaked in large square tanks sufficiently to remove the extreme saltiness and all dust, slime, etc., the length of the soaking depending on the degree of saltiness and varying from 15 to 24 hours. On removal with a dip net they are thrown on a stringing table, where a gang of men stand ready to place them on small square sticks about $3\frac{1}{2}$ feet in length. In stringing them the stick is held in the left hand, the lower end resting under the left elbow; each fish is grasped with the right hand about the head, and by pressing it vertically the gills are opened, when the fish is entered on the stick at the left gill-opening and out at the mouth. Usually about 15 herring are placed on each stick. Each stick with its load of herring is then dipped in water for a moment and allowed to drain, and placed in the smokehouse. At Gloucester the salted herring are soaked for only a few moments before stringing, and round sticks, $\frac{1}{2}$ inch in diameter and 2 feet long, are used. The sticks with the attached herring are then immersed in tubs or vats which are filled with fresh water, and the fish are soaked from 8 to 16 hours to freshen them. On removal they are allowed to drain for a few moments, and are then placed in the smokehouse.

When fresh herring from neighboring points are used, as at Portland and Eastport, they are immediately pickled on their receipt at the smoking establishments, about a bushel of salt being used to each barrel of fish. After remaining in the pickle for 2 or 3 days they are removed, drained, and placed on the ordinary herring sticks, and hung in the smokehouse and smoked like the Newfoundland salted herring.

In order to "bloat," the herring must be thoroughly moist, and after they have commenced to dry in the smokehouse the heat must be increased. If they are permitted to hang 10 or 12 hours without heating they will not bloat, but will become hard herring. The smoking is continued from $2\frac{1}{2}$ to 6 days, when the fish are usually sufficiently cured. They are removed from the houses, allowed to cool for a few hours, and placed in boxes holding 50 or 100 fish each, the larger size being by far the most numerous. The average weight of 100 bloaters prepared from Newfoundland herring is about 40 pounds, whereas an equal quantity prepared from Gulf of Maine fish weighs from 25 to 35 pounds, according to their size and the extent of the smoking. The Eastport bloaters weigh about 25 pounds per 100 fish, being smoked 2 or 3 days longer than the Boston bloaters, as they are intended to keep a greater length of time and in warmer climates. They are placed in boxes $18\frac{1}{2}$ inches long, $11\frac{1}{2}$ inches wide, and $7\frac{1}{2}$ inches deep, inside measurement. The thickness of the ends is generally $\frac{7}{8}$ inch and of other parts $\frac{3}{8}$ inch, and the cost of boxes approximates $12 per 100. The boxes at Boston, Gloucester, and Portland are usually considerably larger. One barrel of round fresh herring yields about 5 boxes of 100 bloaters each. Those smoked $2\frac{1}{2}$ or 3 days will keep usually 3 or 4 months under favorable conditions, while those smoked 5 or 6 days will keep until warm weather. Very few bloaters are sold after the month of May.



CARRYING HERRING HORSE FILLED WITH STICKS OF HERRING INTO SMOKEHOUSE, COAST OF MAINE.

The market for bloaters is principally in Boston, New York, Canada, and the West, and the average wholesale price for those prepared from Newfoundland salted herring is about $1.20 per 100 fish. The Boston-cured bloaters sold in 1859 at $1.25 to $1.50, and in 1865 at $1.80, per 100. In 1880 the value of the Eastport bloaters was about 95 cents, in 1893 it was 77 cents, and in 1898 it was about 80 cents per 100.

The cost of preparing bloaters at Eastport is considerably less than at Gloucester or Boston. At Boston it approximates 84 cents per box of 100, as follows:

Salted fish (at $2.50 per barrel of 550)	$0.45
Cost of smoking and packing	.25
Box	.14
Total	.84

During the past two or three years some curers have packed bay leaves between the layers of bloaters in the boxes, but fish so packed have a tendency to mold when placed in cold storage. Choicest bloaters are very little salted, and are smoked so slightly that there is little discoloration of the skin, but prepared in that way they will keep only three or four days. These mild-cured bloaters are very popular in Great Britain, but are not prepared in this country to any great extent.

The "pickling" or "bückling" prepared in New York City are quite similar to the bloaters prepared at Boston. The large fat frozen herring from Newfoundland are used, their average weight being nearly a pound each. These are placed in cold storage, whence they are removed from time to time, as the trade requires. On removal they are thawed out and pickled round for 10 or 12 hours and placed on rods in the smokehouse, and after smoking cold for 8 or 10 hours they are placed in the smoke oven and hot-smoked or cooked for an hour or two. About 10,000 pounds of these are prepared in New York City annually, selling at about 12 cents per pound. These fish are sometimes beheaded and eviscerated before being smoked, and are then sealed in tin cans, small fish being selected for this purpose.

Labrador and Newfoundland split herring, salted in barrels, are also smoked in New York City and a few other points, but the business is not so extensive as formerly, probably not exceeding 12,000 pounds annually. These are soaked out, strung up, and cold-smoked for 8 or 10 hours, just enough to give a slight color to them. In New York they are generally tied 3 in a bunch and sold to the stores at 6 or 7 cents per bunch.

The preparation of bloaters is much more extensive in Great Britain than in the United States, Yarmouth being the principal place where they are cured. Usually they are prepared for immediate consumption and are smoked for 10 or 12 hours only. When using fresh herring, the fish are placed in strong brine for 6 or 8 hours, then washed in clean water to remove scales, slime, etc., placed on smoke-sticks by pressing the latter through the gills, dipped or rinsed in water, and suspended in smokehouses, where they are smoked for 10 or 12 hours at a temperature of about 80°. When using salted herring, they are soaked for a time to remove the excess of salt, the length of the soaking depending on the degree of saltiness of the fish.

The delegates appointed in 1889 by the Canadian government to inquire into the herring industry of Great Britain and Holland, state as follows regarding the Yarmouth bloater industry, on pages 30-31 of their report:

One of the best bloater curers in Yarmouth informed us that one reason why his fish stood so high in the market was that he was always very careful, in the first place, to select the very best fish for the manufacture of bloaters, reserving for other purposes all inferior and unsuitable fish. Then he is very careful in salting, curing, and smoking them. We saw in the fish stores in Yarmouth,

also on Billingsgate market in London and on the tables in the hotels, a bloater very slightly salted, and smoked so slightly that there was no discoloration at all of the herring. This bloater so prepared is a most delicious fish. It is prepared in this way for immediate use in the nearest cities, towns, and country places, and will only keep some three or four days. Other classes of bloaters, intended for consumption at greater distances and therefore designed to keep longer, are more highly salted, smoked in various grades. The bloaters we saw were fairly fat, but very fat herring will not do for bloaters. Bloaters are salted in heaps on the stone floors of the warehouses—some for a few hours, some for one or two days or more. They are never so highly smoked as the mildest red herring. There is no difficulty in manufacturing bloaters. All that is required is intelligence, good judgment, quick observation, and honesty of purpose, together with a knowledge of the tastes of the consumers; and also whether the fish is required for immediate use near by or for exportation to places at a distance. The gentleman who gave us so much information said that first of all he required to know exactly the kind of bloater required and that he then did his best to supply the article. When the herring have been quite sufficiently salted, they are washed clean on the outside, but are not opened, gibbed, or gutted. They are then strung on rods and hung up to drip and dry, and then smoked. The fuel preferred in Britain for smoking purposes is the sawdust or the waste from the turning lathe of birch, although oak and elm are sometimes used. All agreed that the birch made the sweetest smoke. The white bloaters put up for immediate use are packed in neat light boxes, containing 50 herrings each. Those more highly salted and smoked are put up in larger packages. The bloaters we saw were considerably smaller than our own herring; they are deep from back to belly, and are an excellent fish. Too much attention can not be given to the selection of the herring used for bloaters and to the respective curing processes. The excellence of any particular curer's bloaters does not arise from any special mode of curing, but from special care and attention and that practical knowledge which close observation and experience alone can confer. At the hotel bloaters were opened and split from the belly to the backbone, the gills and viscera taken out, and the herring, without being washed, cooked with the milt and the roe. The roe furnishes pleasant eating.

In the case of bloaters for immediate use, the herring may be put, immediately after being landed and selected, into a strong pickle from six to eight hours. They are then put on the spits and washed by dipping in large tubs of salt water or very weak brine, and then hung up in the smokehouse. The fires should have been burning previously, therefore emitting only a light smoke. A few hours—six to ten—in the smoke room will suffice. They should be cooled off before being packed for the market.

The bloater business in Britain is simply enormous and uses up an immense amount of herrings, thus greatly benefiting the fishermen and the curers, who realize at once on this branch of the herring industry, while the public are supplied with herring in an agreeable and popular form.

KIPPERED HERRING.

Comparatively few kippered herring are prepared in the United States, the round bloaters being so much more popular. The kippered herring are split along the back from the head to the tail, like mackerel, eviscerated, washed, and salted in a manner similar to that applied to bloaters, except that they are not kept in the pickle so long. They are next hung up to dry for a few hours, then smoked for 6 or 8 hours at a temperature of 80° or 85°, each fish being suspended by the napes to keep its abdomen open. With the exception of splitting, the cure is similar to that of bloaters. They sell for about $2 per 100, but the trade is of very limited extent.

The Canadian delegates previously referred to reported as follows regarding the kippered-herring industry of Great Britain:

There is a very large business done in kippered herring in Britain. Herring put up in this way are in great demand everywhere and are preferred by many to the bloater. The very best herring are required for the kippering process. The herring of the west coast of Scotland are in great request for this purpose. The fish used for kippers should be had as soon as possible after they are taken out of the water. They are then carefully selected as to size and quality. Where we saw them at work an active girl stood at a bench laying the herring on its side with the back toward her; with two cuts of a sharp knife she split it from mouth to tail, and with a third motion of the knife she scraped out the stomach and gut and any loose blood inside the fish. She did her work with great rapidity. The herring were then placed carefully into vats of pickle, where, being for immediate use, they remained

for 35 minutes, and were then carefully taken out and placed in baskets to drip. They were then spitted on fine rods containing from 12 to 20 herrings each, and hung up in the smokehouse and smoked for a few hours—five or six—then cooled off and packed up in small boxes and dispatched to London by train before midnight of the day on which the fish were caught. When the fish are intended to be kept longer more salt and more smoke are applied. Where circumstances are favorable kippering may be carried on to advantage either on a larger or smaller scale. Herring put up in this way are most delicious They cost a trifle more, because of the extra labor and the greater care requisite in handling them. The same materials are used for smoking kippers as are used for smoking bloaters and the same conditions apply, only that kippers, presenting a larger surface to the smoke as they do, do not require to be so long exposed to the smoke. As in the case of bloaters and red herring, the tastes of the consumers must be ascertained and the curing as to salt and smoke regulated accordingly. The manufacture of kippers is greatly on the increase in Britain. It is an important branch of the herring industry and utilizes a large proportion of the British catch of herrings.

SMOKED ALEWIVES OR RIVER HERRING.

River herring or alewives are smoked in a number of localities, but principally in Maryland and Virginia, and to a less extent along the Delaware and Hudson rivers and in the waters of North and South Carolina. In New England smoked alewives are prepared at Taunton and at Boston, as well as on the Connecticut River; but most of the supply of these fish in the New England States is from New Brunswick. The trade is mainly during the spring and early summer months, more particularly in April, May, and June, when there are few other smoked fish on the market. The business is not concentrated, but is participated in by many small smokers located at numerous points on the Atlantic seaboard. For this reason it is difficult to estimate the quantity smoked annually with any great degree of accuracy, but it is probably not far from 5,000,000, their wholesale value being about $90,000.

In preparing these fish in the Chesapeake region they are washed in vats and scaled with a knife as soon as practicable after removal from the water. They are next immersed over night in strong brine, containing 12 to 14 pounds of Liverpool salt to each 100 pounds of fish, with some dry salt on top to strengthen the weak pickle that rises to the surface. The following morning the round fish are strung on smoke-sticks, the stick being usually entered at the left gill-opening of each fish and out at the mouth, as in case of hard herring or bloaters on the New England coast. The strings of fish attached to the stick are then dipped in fresh water to rinse them off, and after draining and drying for a few hours are suspended in the smokehouse about 6 or 8 feet above the fire, and exposed to a dense but cool smoke made of pine shavings or similar material for about 2 or 3 days. Care must be taken to prevent the fire from becoming too hot, thus causing the fish to crack at the lower end or possibly to fall from the sticks to the floor. Prepared in this manner the river herring will usually keep in good condition in the Chesapeake region for 30 days during the spring and for a somewhat less period in the summer. As the fish are not eviscerated before smoking the decrease in weight is small, 100 pounds of round fish yielding about 85 pounds smoked. The wholesale price is about 20 or 22 cents per dozen, according to the size and condition.

In Washington, Baltimore, and one or two other places the river herring are prepared in the following manner:

The fresh herring are scaled with a knife, gibbed like the pickled herring of Scotland, washed, and pickled for 3 hours in brine, about 20 pounds of Liverpool salt being used for each 100 pounds of fish. On removal from the pickle they are strung on small iron rods, the rod passing

through the eye sockets of the fish, drained for an hour or so, and hung in the hogshead smokehouses, in the bottom of which a fire has been made of equal quantities of oak and hickory wood. The fish are dried for a few minutes and then the tops of the hogsheads are covered with old salt sacks or other suitable material. From time to time the fire is sprinkled with water to produce a vapor and the fish thus exposed to heat, smoke, and steam for about 3 hours, when they are removed and cooled and are then in condition to be eaten. Only oak and hickory should be used as fuel, as other materials do not produce the proper flavor. If the fire becomes too warm it should be smothered with oak or hickory sawdust.

Herring thus prepared sell for about 40 cents per dozen wholesale, and the trade is at times quite extensive. During the season 1,000 dozen are usually shipped each week from Washington to New York City.

The process of smoking alewives commonly employed in the New England States differs from the Chesapeake process in a few minor particulars. The smokers are usually not so careful about removing the scales with a knife, depending generally on the frequent handling of the fish to scale them if cured soon after removal from the water. It is also customary in salting the fish to permit them to make their own pickle, the fish remaining in the pickle for 3 to 5 days. On removal they are soaked in fresh water for 5 to 6 hours and strung on hard-wood sticks, the stick entering through the left gill-opening and out at the mouth. They are next rinsed, drained, and dried for a short while and suspended in the smokehouse, where they are exposed to a smoldering fire of hard wood and sawdust for 3 or 4 days, when, after cooling, they are ready for sale.

The wholesale price in New England is usually from $1.50 to $2 per 100.

In Massachusetts so few smoked alewives are prepared that little attention is paid to the following law respecting the methods of inspecting and packing:

Sec. 48. Alewives or herrings intended to be packed for sale or exportation shall be sufficiently salted and smoked to cure and preserve the same, and afterwards shall be closely packed in boxes in clear and dry weather.

Sec. 49. Smoked alewives or herrings shall be divided and sorted by the inspector or his deputy, and denominated, according to their quality, "number one" and "number two." Number one shall consist of all the largest and best-cured fish; number two, of the smaller but well-cured fish; and in all cases those which are belly-broken, tainted, scorched or burnt, slack-salted, or not sufficiently smoked shall be taken out as refuse.

Sec. 50. Boxes made for the purpose of packing smoked alewives or herrings, and containing the same, shall be made of good sound boards sawed and well seasoned, the sides, top, and bottom of not less than ⅝-inch boards, securely nailed, and shall be 17 inches in length, 11 inches in breadth, and 6 inches in depth, in the clear, inside.

Sec. 51. Each box of alewives or herrings inspected shall be branded on the top by the inspecting officer with the first letter of his Christian name, the whole of his surname, the name of the town where it was inspected, with the addition of "Mass.," and also the quality of "number one" or "number two." Herrings taken on the coast of Nova Scotia, Newfoundland, Labrador, or Magdalen Islands, and brought into this State, shall also be branded with the name of the place or coast where taken.

Sec. 52. The fees for inspecting, packing, and branding shall be 5 cents for each box, which shall be paid by the purchaser, and the inspector-general may require from his deputies 1 cent for each box inspected, packed, and branded by them.

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Sec. 54. No smoked alewives or herring shall be exported from this State unless inspected and branded as aforesaid, under a penalty of $2 for each box exported, nor shall alewives or herrings be taken from a box, inspected and branded as aforesaid, and replaced by others of an inferior quality, with intent to defraud any person in the sale of the same, under a penalty of $5 for each box so changed: *Provided,* That all smoked herrings and alewives arriving from any other State in the United States, and having been there inspected, may be exported in a vessel from this State without being reinspected. (General Statutes of Massachusetts, 1859, ch. 49.)

New Hampshire has laws somewhat on the same lines as the preceding, but very few alewives are smoked in that State.

SMOKED LAKE HERRING AND WHITEFISH.

Formerly along the shores of the Great Lakes and in the fish markets using supplies therefrom, many whitefish were smoked, but the increasing scarcity of that species gradually led to the substitution of lake herring, and during recent years very few whitefish have been prepared in this manner. The trade in smoking lake herring is quite extensive, amounting to probably 2,000,000 pounds annually, prepared principally at Chicago, Milwaukee, Detroit, Sandusky, Cleveland, Buffalo, Cincinnati, Erie, New York, Baltimore, and Washington.

The process of smoking lake herring and whitefish is identical. If the fish are frozen when received at the smokehouse, they are thawed in the open air or, better, by immersing and stirring them in a barrel of water of medium temperature. After thawing they are split down the belly to the vent, eviscerated, washed thoroughly, and pickled in butts or barrels, about 4 pounds of fine salt to 100 pounds of fish being scattered among them and sufficient brine of 90° salinity to cover them. Either dry salt or brine alone may be used, the former being preferred in warm weather and the latter during the winter. In case brine alone is used, some dry salt should be placed on top to strengthen the weak pickle floating at the surface. After remaining in the pickle from 10 to 16 hours, according to the strength of the pickle and the flavor desired, the fish are removed and strung on the smoke rods, 10 to 20 fish to each rod, according to its length and the size of the fish.

In stringing, some curers pass the rod through the body immediately below the nape bone, effectively preventing the fish from falling down in smoking, but also marring its appearance somewhat. A more usual way is to pass the stick in at the right gill-opening and out at the mouth. Others pass the rod through the head near or through the eyes, and a few pass it immediately back of the throat cartilage. The latter leaves a neat appearance, yet it permits more fish to fall in the smoking process than when the rod is passed through the head or the shoulders. In some houses the smoke-stick is not passed through the fish, but instead a stiff iron wire, curved in S shape, is used to attach the fish to the stick, one end of the wire passing through the fish at the head or beneath the nape bone and the other hung over the smoke-stick. At Grand Haven, and to some extent in Chicago, Milwaukee, and one or two other places, the fish are secured by having stout smoke-sticks, about 1½ inches thick and 2½ inches wide; in the top of each, and about three-fourths of an inch from the edge, is driven a row of tacks or small wire nails at intervals of about 3 inches, projecting about one-half inch above the surface. Ordinary cotton wrapping cord is tied to the wire nail at the end of each stick, and by means of this cord passing around each nail a single herring is held in place between each two nails throughout the length of the stick, the fish being placed with the back of the neck against the stick and the cord passing from one nail around the throat of the fish, entering under the gills on each side, and then around the next nail, and so on to the end. By having the stick of sufficient width, a row of small nails may be placed on each edge, so as to attach a row of fish at each side. This removes nearly all risk of the fish falling, and their appearance is not marred by holes through which the smoke-stick has been passed.

Some markets prefer the herring well smoked on the inside, and to accomplish this the sides of the abdominal cavity are stretched open by means of small wooden sticks or toothpicks, either one or two sticks to each fish. This permits the smoke to permeate the stomach cavity better and results in a more durable article. In general, the Western trade prefers the stomach cavity stretched open, while the Eastern markets prefer them without the sticks; but there are exceptions. The smoked lake herring sold in Washington are mostly extended by means of a small stick, or, in case of large fish, by two small sticks.

The fish attached to the sticks are dipped in fresh water to remove surplus or undissolved salt, loose scales, etc., unless they have been rinsed before stringing, drained, and suspended in the smokehouse 4 to 8 feet above the floor, and subjected to a gentle smoke for 4 or 5 hours. The door or damper is then closed, the fires spread or built up and the fish cooked for 1 or 2 hours according to the amount of fire, the height of the fish, and the particular cure desired. After cooling, which is accomplished either by opening the doors of the smokehouse or by removing the fish to the outside, they are ready for the trade. 100 pounds of round fish, or 85 pounds dressed, yield about 65 pounds smoked. Ordinarily these fish keep one or two weeks, and even longer, and the wholesale price ranges from 6 to 12 cents per pound, according to the locality and the season, the former being the price for the Great Lakes and the latter for New York City. In New York about 100,000 pounds of these fish are smoked annually and they sell throughout the year, being known usually as ciscoette, competing with pickling or bückling. In Washington the smoked lake herring are usually sold by the number, averaging about 50 cents per dozen wholesale.

In some of the north European countries the sea herring are smoked in a manner similar to the lake herring in this country. The following description of a smokehouse in Holbek, Denmark, and the methods used therein, is from *Fiskeritidende*, No. 41, Copenhagen, October 7, 1884:

As soon as the herring are brought in from the boat, they are placed in strong brine for 3 or 4 hours, or they are left over night in a weaker brine. Some people also use the dry-salting method. The fish are then washed and strung on round, wooden sticks, three-fourths of an inch thick and 3 feet long. This stick is stuck through the gills and comes out at the mouth. According to the size, from 18 to 21 fish are strung on every stick, always in such a manner as not to touch each other. They are then hung in the open air and dried in the sunshine, if possible, and then put in the oven for smoking. The smokehouse has four ovens, built from time to time as the demands of the trade required. From 16,000 to 24,000 herring can be smoked per day. In one of three large ovens 1,600 herring can be smoked at the same time. The chimney itself should not be less than one yard square on the inside, as otherwise it is not capable of receiving the steam from the fish when they are dried in the oven. The top should be covered with a thin plate of cast iron, so that the rain can not fall on the fish. For supporting the front part of the oven it is best and cheapest to use an old iron rail; any other bar will scarcely be strong enough. The oven can easily be only half the size of one of the larger ones, but the larger it is the more profitable it will be as regards the quantity of fuel consumed. In front of the oven iron plates are hung on an iron pipe, and these plates are taken off when shavings are put on the fire. From these plates and up to the iron bar the opening is covered by a piece of linen cloth, as it is necessary to look into the oven frequently in order to see that the flames do not rise too high and burn the tails of the fish. If this should be the case, the flames must at once be quenched by moist sawdust. The fuel used is exclusively oak and beech shavings, particularly from coopers who make large barrels, as the shavings must not be too fine; beech and oak sawdust are also used, but shavings and sawdust of pine wood should never be employed, as it is apt to give to the fish a resinous flavor. The smoking process may take from 3 to 6 hours, according to the drying which the fish have undergone in the air. After the fish have been smoked they are generally allowed to hang one night to cool off, and are in the morning packed in boxes holding 80 fish each.

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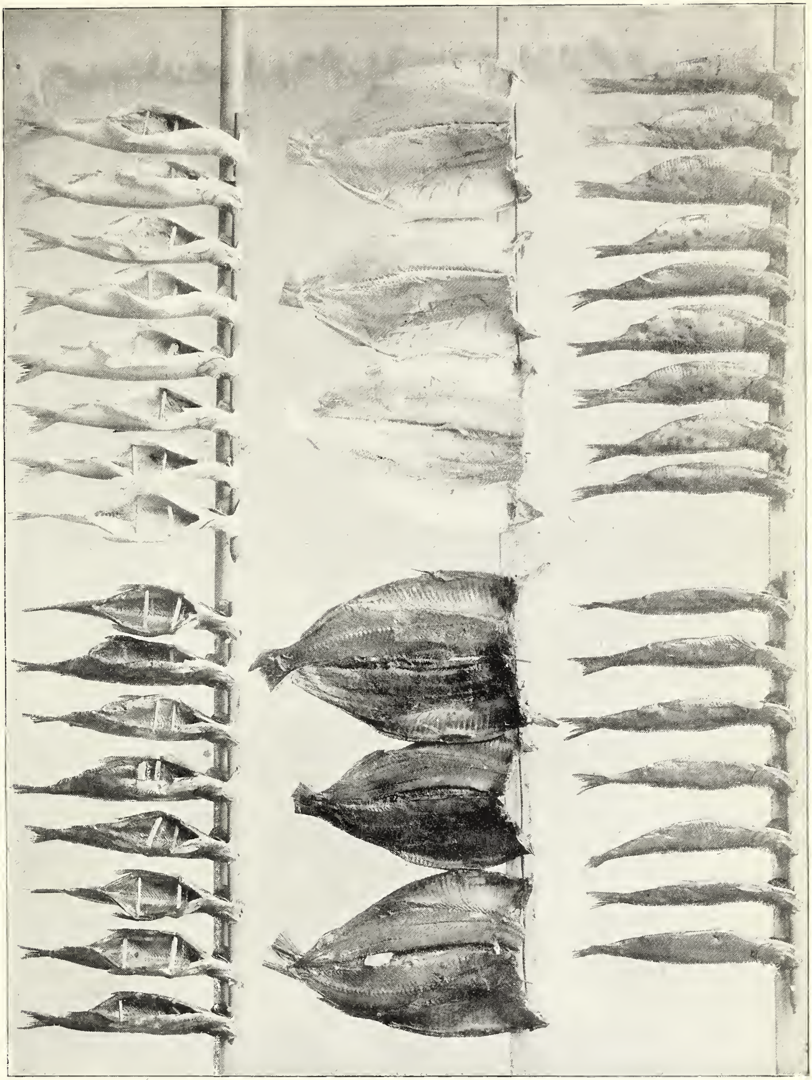

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MANNER OF "STRINGING" CERTAIN VARIETIES OF FISH FOR SMOKING AT WASHINGTON, D. C.

1. Smoked Potomac herring. 2. Smoked Labrador herring. 3 and 4. Salted shad before and after smoking. 5 and 6. Lake herring before and after smoking.

SMOKED SALMON.

Smoked salmon is among the choicest of fishery products, and its cure represents the highest development in fish-smoking as practiced in this country. The annual product approximates 2,800,000 pounds, which is sold at from 16 to 45 cents per pound wholesale. It is prepared principally in New York, Boston, Chicago, and Philadelphia, there being 8 or 10 smoking-houses in New York City and vicinity, 4 in Boston, 2 or 3 in Philadelphia, 2 in Chicago, and several on the Pacific coast and other points.

The great bulk of the supplies for the smoking-houses consists of salmon pickled in barrels, which come principally from Labrador, Newfoundland, and Hudson Bay, and more recently from Alaska and other Pacific coast points. The trade in pickled salmon from the east coast of the British Provinces, known to the trade as Halifax salmon, began early in the present century, developed principally between 1830 and 1840, and since has ranged between 3,000 and 10,000 barrels annually, the receipts during the last 30 years averaging 5,500 barrels, valued at about $15 per barrel. The Pacific coast salmon have been used for smoking in the Eastern States only since 1885, and the extent of their use was of little consequence prior to 1890. The favorite pickled salmon for smoking are those from Hudson Bay, with Labrador and Newfoundland ranking next in order. They range in weight from 5 to 13 pounds salted, except that some few from the Hudson Bay weigh even 20 pounds, and the wholesale price in Boston or New York during the past few years has been from $17 to $20 per barrel of 200 pounds. Practically all of the pickled salmon from the east coast of the British Provinces are smoked, the quantity going to the consumers in brine being less than 2 per cent. While not so red as the Pacific coast salmon, they are richer and finer-grained. The Pacific salmon cost on the Pacific coast usually about $9 or $10 per barrel of 200 pounds, while the cost of transportation to the Atlantic coast by rail is $3.30 and by vessel $1.20 per barrel.

The choicest salmon for smoking are those received fresh or frozen from Nova Scotia and New Brunswick, especially from the Restigouche River and vicinity. They are quite large, averaging 12 or 14 pounds each, some attaining a weight of 40 pounds or more. Some curers use fresh salmon only when the New York market is so glutted as to run the price down below 10 cents per pound dressed, the fish being then purchased, brine-salted, and kept for the smoking season. But the best class of smokers receive regular shipments from the Restigouche and vicinity and place them in cold storage, whence they are removed for smoking as the trade demands. Many years ago, when salmon were abundant in the Penobscot, Kennebec, and Connecticut rivers, they were smoked in Maine and Connecticut, but practically all New England salmon are now consumed fresh. Since the salted fish constitutes the bulk of the receipts at the smoking-houses, the methods of their treatment are first described.

As the daily needs of the trade require, the salmon are removed from the barrels, immersed in vats of fresh water for 2 or 3 hours, then washed with a bristle brush to remove incrusted salt, slime, etc., and immersed in another vat of water for 16 to 60 hours, according to the temperature of the water and the degree of saltiness of the fish. If desirable, the length of the soaking can be shortened by using warm water. In some houses they are soaked for 12 hours in running water. The fish are then water-horsed in piles, skin up except the lower layer, the piles being 2 or 3 feet high, with boards on top on which stones are placed for compressing the fish, but water-horsing is not practiced by all curers. After this pressure has been applied 4 or 5 hours the

flesh of the fish is smoothed with the side of a flat knife, all ragged parts being pressed down. Each fish is then trussed with two or three thin, flat wooden sticks, so as to keep it spread out, the rough-pointed sticks being fastened transversely across the back on the skin side, the end of each stick slightly entering but not passing through the skin. If the heads have been left on, as in case of northern or Halifax salmon, a small stick or pin of hickory or other hard wood is shoved through the head at the eyes. A rope-yarn cord is next passed around this pin and about the gills, or about the uppermost of the flat stretching-sticks, in such a manner that when suspended thereby the weight is distributed proportionately and by means of which the fish may be hung from the sticks in the smokehouse. The Pacific coast salmon, which have the heads removed, are usually tied up by a cord passing through the napes or around the tail, and if very large they are sometimes cut into strips before being smoked. Some curers hang the fish up by means of five or six iron or wire hooks passing through the flesh, thus doing away with the sticks and cords above described.

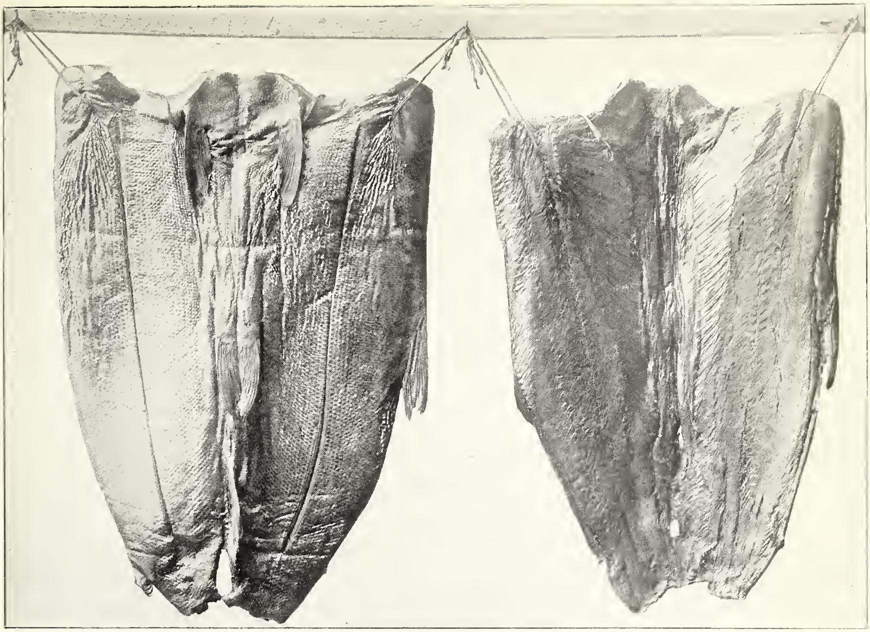
The fish are permitted to drain for several hours, when they are hung in the upper part of the smokehouse, away from the heat, but not so high as to be in the warm air which accumulates at the top of the bay. Usually only two rows or tiers are smoked at a time, and in the lofty smokehouses the smoking is continued for 18 to 36 hours. About 24 hours are usually required, but on dry windy days 16 to 18 hours are sufficient, and during sultry weather 30 or more are necessary. When low smokehouses are used, in which the fish are hung within 8 or 10 feet of the fire, as at Washington, D. C., the smoking is usually completed in about 12 hours. The smoke should be even throughout and with little fire. In some houses a light fire is built under the fish as soon as placed in the smokehouse, and this is continued for 6 or 7 hours, when a shovelful of sawdust is added and the smoking continued 12 or 14 hours.

When sufficiently smoked, the fish are permitted to cool and are then packed, usually with paper or matting wrapped about them, the spreading-sticks at the back being left in. A barrel of pickled salmon yields about 180 pounds of smoked fish if the smoking be done in October, but if postponed until the following June it will yield only about 165 pounds. The average wholesale price in New York or Boston for smoked Halifax salmon is about 18 to 20 cents per pound, and for Pacific coast fish about 12 to 14 cents per pound. They will keep in good condition for 10 days or longer under favorable conditions, but are used mostly in the vicinity where cured. Smoked salmon have been shipped to New York from Nova Scotia, but although they looked well on being opened they had a tendency to mold soon after being unpacked.

The following general method of smoking salted salmon in Sweden and Germany differs from the foregoing in several particulars:

> The fish are immersed for 48 hours in soft cold water, which during that time is changed at least three times. Then with a medium stiff brush and warm water each fish is well cleaned outside and inside, and by means of a cord about the tail is hung in a tub of clear cold water, where it remains for 12 hours, when it is suspended in the air for 6 hours to dry. After that it is laid on a clean table, and when well drained it is trussed or braced with three sticks along the back, as in case of Halifax salmon, and suspended for 2 hours in the smokehouse over a gentle heat, then subjected to a dense smoke for 24 to 36 hours, until it acquires a dark-red color. The cure is then complete, and after cooling the fish is ready for the market.

In preparing frozen salmon for smoking, the fish on removal from cold storage are thawed out either by immersing them in water over night or laying them on boards in a moderate temperature and turning them over every 2 or 3 hours for 8 or 10 hours,



SMOKED COLUMBIA SALMON, BACK AND FRONT VIEW, SHOWING MANNER OF DRESSING AND HANGING.

PACKING FINNAN HADDIE. (See page 500.)

when they are usually sufficiently thawed for handling. The fish are then split down the belly from head to tail, so as to lie out flat, the viscera removed, and in some cases the head and four-fifths of the backbone. This is customary with the Pacific coast salmon, but in New York and Boston, where Nova Scotia salmon are used principally, the head and backbone generally remain. In some instances the fish are split down the back, depending on the state of their preservation.

If the fish must be handled with little expense, so as to sell at a low price, they are next placed in tight barrels or butts with about 50 pounds of No. 2 salt and from 5 to 10 pounds of granulated sugar to 200 pounds of fish. On the second day add brine made by dissolving 30 pounds of salt in 5 gallons of water. After the fifth or sixth day the fish are removed and soaked in fresh water for about 3 hours, and are then attached by five or six hooks to the smoke-sticks, dried, and smoked in the manner described for salted salmon. The product by this method sells for 20 to 30 cents per pound wholesale, but sometimes much lower. In Chicago in 1898 the writer saw salmon which had been held in cold storage for three years and then smoked after the above method and sold at 16 cents per pound, resulting, of course, in no profit because of the heavy cold-storage charges.

Usually much more care is exercised in preparing smoked salmon from fresh or frozen fish, and especially when using Nova Scotia fish. Immediately after thawing, or after removal from the ice, if fresh, the fish should be sponged dry and a mixture of equal parts of saltpeter and salt introduced into the thick portion of the flesh. This may be accomplished by making 3 or 4 cuts about 8 inches apart through the skin, but not so far as to penetrate the stomach membrane, after which the openings are closed as well as practicable by bringing the cuts together; or it may be introduced by means of a small hollow tube with a plunger to force it in as the tube is withdrawn. The fish are next split and eviscerated and carefully rubbed by hand with a composition of salt and saltpeter, 2 parts of the former to 1 part of the latter. This mixture is thoroughly spread over each fish, and at the same time wherever the surface is cut or broken the fibers are brought together, so that the fish presents a smooth, neat appearance. A curer on the Pacific coast runs a small instrument down the thick part of the flesh on each side of the backbone and thus removes about one-fourth inch of skin on each side the full length of the back, so that the saltpeter and salt may quickly permeate the flesh. The fish are next placed in hogshead butts, skin down and 3 or 4 fish to the layer, with one-half inch of salt in the bottom and sprinkled over each layer of fish. Pickle of about 90° test is then added to cover the fish, and after remaining in pickle about 2 days they are removed and prepared for hanging up, by placing a wooden pin through the head and 2 or 3 flat sticks at the back to stretch the fish out in the manner already described. After passing a rope-yarn about the sticks the fish are suspended in running water for 30 or 40 minutes and then hung in the open air about 6 hours to drain and be partly dried by the wind, when they are suspended in the upper part of the smokehouse, away from the heat, and subjected to a gentle smoking for about 24 hours under normal conditions. Salmon cured in this manner are known usually as Nova Scotia salmon, in contradistinction to the salted salmon from the north, generally known as Halifax salmon. 100 pounds of round fish make about 65 or 70 pounds smoked, which sell for 30 to 45 cents per pound wholesale and 60 to 75 cents per pound retail.

With a view to preventing the inner surface of salmon and similar fish from cracking, which injures its appearance and also makes it liable to mildew quickly, and to

prevent the fish from falling from the smoke-sticks, and to retain the natural juices, a process has been invented by which a piece of membranous material, such as animal bladder, etc., is placed in contact with the inner surface of the fish, which by means of its natural glutinous ingredients is held there securely. Then the fish, covered on the outside by its natural skin and on the inside by the artificial coating, is placed horizontally in a frame consisting of a number of triangular transverse metal-frame standards having base ledge projections and wire-screen surfaces fitted thereon, inclined in opposite directions and open at the back and bottom, for exposing the fish to the smoke.*

In smoking fresh salmon in Holland each fish is wiped clean, split down the back from the nose to the tail, the head being left on, and several incisions made inside of the abdominal cavity in the thick of the flesh, but not sufficiently deep to penetrate the skin. The blood is carefully washed out, the stomach cavity well cleaned, and the whole fish washed several times. The skin is then cut or gashed laterally nearly the length of the fish, and on each side of this cut several short ones are made, this being done to permit the salt to penetrate the flesh more readily, so that each part of the fish may become equally salted. In salting, the fish are placed on top of each other in heaps of about 6 salmon each on tables, with the flesh upward.

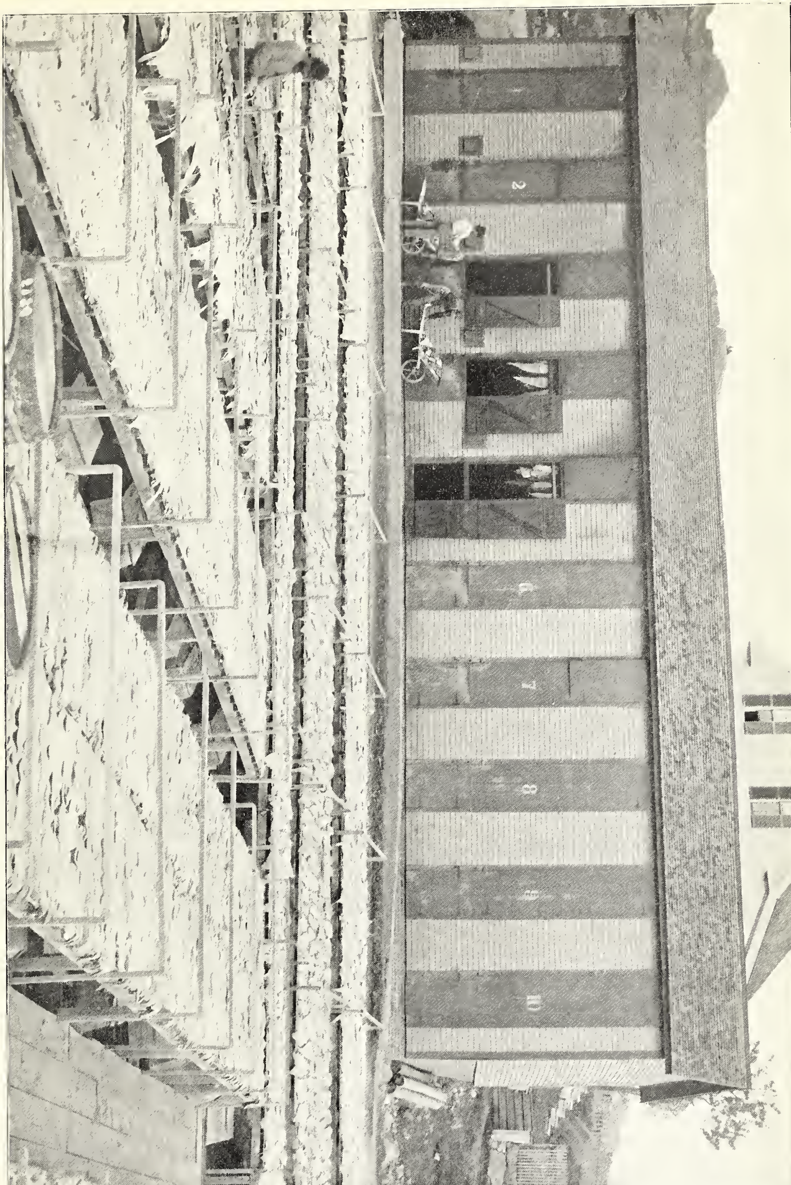
In making the piles, each fish is well sprinkled with fine Lisbon salt, and to prevent the stomach from forming a receptacle for the brine by sinking down, a thin, curved oak board is laid between the fish. The fish remain in piles from 2 to 4 days, when they are struck through sufficiently for smoking; but if they are not needed at once, they may be kept in ice houses or cold cellars for 2 or 3 months. Before the fish are smoked they are well washed and hung up to dry in the air, or during damp weather they are dried in the smokehouse. A fire is made from small pieces of oak wood in the center of the floor, and after this has burnt half an hour a smoke is made with oak shavings and fagots, over which ashes are scattered. For some markets the fish need not be smoked more than 12 or 14 hours, but for other markets it is necessary to smoke them 3 or 4 days.

The following method of smoking fresh salmon prevails in Germany: Each fish is first rubbed free from slime, etc., with a towel which has been dipped in salt or brackish water; then it is split down the belly, eviscerated, and thoroughly cleaned inside as well as outside. Most of the backbone is removed with a sharp knife, some being left near the tail to strengthen that part of the fish, and the flesh adjacent to the backbone is pressed flat so as to present a smooth appearance, or as though there had been no backbone. Bay leaves, from which the stems have been removed, are next spread thickly with salt on the inside of the fish and the sides brought firmly together. It is then packed in dry salt and bay leaves and a weighted board laid upon the fish. After 30 hours or so under this pressure the fish is immersed in fresh water for half an hour, the salt, etc., in the meantime being wiped off, after which it is laid out flat and trussed in the usual manner with 3 flat sticks and suspended in the air for about 6 hours. When sufficiently aired the fish is placed in the smokehouse and dried by a moderately warm smoke for 3 hours, when the smoke is increased and continued for about 36 hours or until the flesh assumes a bright red color.

A somewhat novel method* of preparing salmon for smoking was introduced in this country in 1878 by Lyman Woodruff, of Ellensburg, Oreg., by means of which it is claimed that much of the original flavor, color, and plumpness of the fish may be retained.

*See Letters Patent No. 577672, February 23, 1897, in favor of C. Waldemann, of Cöslin, Germany.

PLATE XXX.



DRYING AND SMOKING HALIBUT AT GLOUCESTER, MASSACHUSETTS

The inventor's description of the process is as follows:

After the fish is caught I open and clean it. I then place it in clean lime water, in which I let it remain for about 20 minutes. After removing it from the lime water I wash it clean and place it on the table, flesh side up, where I let it lie for about 10 minutes, when I wipe it dry, both inside and outside, with a clean dry cloth. For an ordinary salmon, weighing 16 pounds, I take 1 teaspoonful of finely ground black pepper and rub it well into the flesh side of the fish; next I rub in one-fourth of a teaspoonful of pulverized saltpeter in the same way, and then 1 tablespoonful of fine salt. These substances I rub in separately, rubbing each one until it disappears. The fish having been thus prepared, I sprinkle a thin layer of brown sugar over it and fold the two sides together. I let it lie in this condition for 12 hours, when I wipe the back of the fish dry and apply a coating of linseed oil to the back with a paint brush, when it is ready to be smoked. In smoking the fish I commence by creating a heavy smoke, and allow it to gradually subside in quantity until the proper volume is obtained, in order to keep off the flies.

SMOKED HALIBUT.

The preserving of halibut is effected principally by salting, but in that condition these fish are not readily marketed and smoking is applied to improve the flavor. The industry is confined almost exclusively to Gloucester, Mass., but during the past few years small quantities have been smoked at Boston and other points. Originally the smokers utilized only the surplus halibut from the fresh-fish trade, but the popularity of the article increasing, the Bank vessels began, about 1850, to salt the halibut taken by them when it was inconvenient to take them to market fresh. In 1855 the quantity of smoked halibut prepared approximated 400,000 pounds. The business reached its maximum in 1872, when about 3,000,000 pounds were prepared. Since that time the increasing scarcity of the fish and the enhanced demand for it in the fresh-fish trade have diminished the quantity. In 1880 it amounted to about 2,000,000 pounds, while in recent years it has averaged about 1,600,000 pounds, selling at about 10 cents per pound wholesale.

Although most of the halibut for smoking is received in a salted condition from Grand Bank, Western Bank, Iceland, Greenland, and more recently from Bacalieu Bank, some are received from the vessels supplying the fresh-fish market, when the market is glutted. That was the exclusive source of the supply prior to 1860, when the halibut fishery on Grand Bank and Western Bank was begun. Since the origin of the Bacalieu Bank fishery, in 1895, the smokers have received quantities of surplus gray halibut too large for the fresh-fish market.

Many of these fresh halibut are known among the trade as "seconds" or "sour halibut," the coating or membrane of the abdominal cavity becoming slightly tainted, and since the taint will quickly spread to the entire fish it is necessary that they be salted at once. When the flesh sours it puffs out, and is good for nothing except fertilizer.

The process of dressing and salting halibut is as follows: A dressing or fletching gang consists of two men, and there are four gangs to the vessel. Each being provided with a strong gaff hook having a garden-spade handle, they place the halibut on a slanting cutting board on its dark side. One of the fletchers thrusts a thin knife, about 16 inches long and $1\frac{1}{2}$ inches wide, into the body of the fish near the base of the dorsal fin through to the backbone, the blade being held horizontally, and cuts close to the ribs, removing a broad streak from one-half of the upper side of the fish. The fletcher on the opposite side of the table makes a cut similar to the above, separating the whole upper half of the fish from the backbone and the ribs. Two gashes are then cut in

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* Letters Patent No. 204647, dated June 4, 1878.

the fletch, one at each end, by means of which it is removed from the cutting board. The other side of the fish is then treated likewise, making two fletches from each halibut. Formerly in fishing near Iceland, when all the fins were saved, the fletching knife was entered not so close to the fins, and when the fletches were removed the fins were cut off. During the four or five years preceding 1898 few of the fins were saved on account of their large size and fatness.

The whole fletches are at once salted in kenches in the vessel's hold, in the same manner as codfish, with the skin side down and a layer of Trapani salt over each layer of fish, 8 or 9 bushels of salt being used to each 1,000 pounds of fish. The whole fletches are supposed to hold the pickle better than if they were cut in smaller pieces, and consequently weigh more. After remaining about 15 days they are rekenched, during which time the surplus salt is shaken off. To avoid compression some fishermen place the fletches in large 400-pound boxes and pile the boxes on top of each other. On reaching port the fish are removed from the vessel's hold and placed back down, with salt, in kenches 3 feet high in the fish-house, where they may remain for a year or more without further handling. It is not unusual for smokehouses at Gloucester to have half a million pounds or more of salted halibut on hand at one time. When it is necessary to hold them over during July and August, the appearance of the fish is improved if they are kept cool, and for that purpose one of the halibut smokers at Gloucester has a small ammonia refrigerating plant, with suitable cold chambers connected, where the temperature is kept about 45° or 50° F.

The fresh halibut received at the smokehouses from the market vessels are cut in small fletches and salted in butts, back down, similar to those used for salting codfish, with about 5 bushels of Trapani salt scattered among 1,000 pounds of fish. There they remain from one to two weeks, when they are removed and salted in kenches similar to those on the vessels; or they may be scrubbed, soaked, water-horsed, and smoked at once; but this is not usually done, because of the desirability of working off the old stock. It is important that the fletches be thoroughly salted, otherwise the smoked product will be liable to spoil quickly.

When the market demand warrants their use, the fletches are removed from the kenches, washed thoroughly in fresh water with corn brooms or bristle brushes, and soaked in water for 3 or 4 hours. The water is then changed and they are again soaked for about the same length of time. This soaking is necessary in order to remove the coating of salt from the fish, and to soften its fiber so that the smoke may penetrate the flesh. On completion of the soaking they are water-horsed, skin side up, for 5 or 6 hours with weights on top. They are next placed on flakes similar to those used in curing codfish, where they are exposed to the sun's action for about 24 hours, which may extend through several days, the fish being placed in small piles and covered with flake boxes during the night or rainy weather. After drying the fletches are cut in small pieces, from 2 to 6 pieces to the fletch, with a gash in each piece where the flesh is thin and the skin appears tough.

The fletches are then strung on smooth, round, hard-wood sticks about 2 feet long and $\frac{3}{4}$ inch in diameter, or, as at Boston, small iron or steel rods $3\frac{1}{3}$ feet long, the sticks passing through the splits or gashes cut in the fletches, and from 5 to 7 pieces to each stick 2 feet in length, and 8 to 12 pieces to those $3\frac{1}{3}$ feet long, each piece being 2 or 3 inches from the adjacent ones to permit the smoke to pass freely among them. The sticks with the fletches attached are then passed into the smokehouse.

The principal smokehouse at Gloucester consists of a series of 10 compartments

DRYING HALIBUT FOR SMOKING AT GLOUCESTER, MASSACHUSETTS. SALTING, STORAGE, AND SMOKING HOUSES IN THE REAR.

side by side, and 6 feet wide, 14 feet long, and about 20 feet high. The flooring is of lattice-work, under which is a vault about 6 feet deep for generating the smoke. Within each compartment is a lane or passageway extending the length of the room, on each side of which are arranged 3 sets of parallel bars, one end of each set resting on upright poles forming the side of the lane and the other resting against the wall of the compartment. The first set of parallel bars is about 4 feet from the lattice floor, the second 3 feet above the first, and the third 3 feet above the second and an equal distance below the roof. Upon these bars are placed the ends of the sticks which hold the halibut. Each stick will carry from 5 to 7 fletches and about 20 sticks will rest on each pair of parallel bars. The capacity of each of the 10 compartments is about 120 sticks, or 600 to 800 fletches, equivalent to about 3,000 pounds of smoked halibut.

The fuel for smoking consists principally of ship carpenters' chips of oak, though recently oak edgings have been used, with sawdust to smother the flames. Some houses use sawdust exclusively. This fuel is arranged along the sides of the vault, the entire middle space being left vacant, and the fires are built and continued until the smoking is completed, usually in from 2 to 5 days. In damp weather moisture collects on the fish and the process may then require a week. During the winter it is possible to keep the fires hotter, and the smoking may be completed in 2 days. Care must be taken not to let the fires get too hot, for then the fletches may become too soft to hang on the sticks, dropping to the floor. At all times the doors are kept slightly open to permit a circulation of air to keep the halibut cool, and they will also "take the smoke" better. The entire decrease in weight by dressing and smoking is about 70 per cent, a live halibut weighing 100 pounds producing about 30 pounds of smoked fish; but as received from the kenches in the vessels 100 pounds yield about 82 pounds.

There are three principal grades of smoked halibut, namely, "heavy chunks," "medium chunks," and "strips," classification being made according to the thickness of the flesh. The napes and the thin parts of the tail do not go to the regular grocery or fish trade, being used mostly for "free lunch" at restaurants. While connoisseurs prefer the meat somewhat dark in color, yet the bulk of the trade requires it of a light straw-color. It is packed in boxes ranging in size from 1 pound to 500 pounds, the 30-pound boxes being the most popular. About 4 years ago quite a business was started in packing it in 1-pound and 2-pound "bricks," similar to boneless cod, but the trade was destroyed by persons placing smoked pollock on the market as halibut. During hot weather a small quantity of salt is sprinkled over the halibut as it is being packed in the boxes, and under ordinary conditions the product will keep for 6 or 8 months, or even longer. When intended for warm climates, smoked halibut is sometimes placed in hermetically sealed zinc boxes incased in wooden boxes, the zinc boxes having capacity for 50 pounds each. There is a little trade in smoked halibut placed in small glass bottles, with wide tops covered with cork stoppers.

The market is confined to the northern parts of the United States, none being sent south of Washington except in small quantities to Louisville and Memphis. The principal demand is from New England, New York, Chicago, and the West, the value approximating 9 cents per pound wholesale. In 1876 an effort was made to introduce smoked halibut into the European markets, and samples were sent from Gloucester to London, Liverpool, Glasgow, Cadiz, and St. Petersburg. No returns were received except from London, and English dealers expressed the opinion that it was too salt for their trade. At the Berlin Fishery Exposition in 1880, smoked halibut was exhibited by Messrs. Wm. H. Wonson & Sons, and a medal was awarded for its superior quality.

SMOKED HADDOCK OR FINNAN HADDIE.

The curing of haddock by smoking originated about the middle of the eighteenth century at Findon, Scotland, the cured product being known in the English markets as "Findon haddie," which later was modified into "Finnan haddie." Originally it was salted and dried, and afterwards soaked and placed over a smoldering fire of dried peat. But the demand soon becoming very great, it was cured in special buildings erected for the purpose, and at present large quantities are prepared at Aberdeen, Scotland, at Grimsby and Hull, England, and at other places in northern Europe in a manner similar to that employed in the New England States.

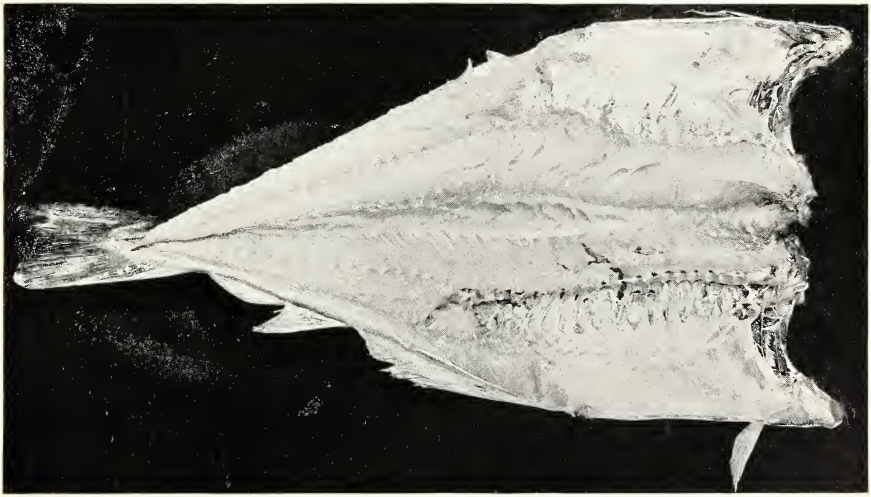
Finnan haddie was first prepared in the United States at Rockport, Mass., about 1850, but the business was soon abandoned. About ten years later Thomas McEwan, a Scotchman, began to cure it in a small way, at Portland, Me., the product being marketed principally in Canada. D. Weyer engaged in the business about 1865, and on Mr. McEwan's death in 1872 he was succeeded by John Loveitt. From time to time other firms came into the business, and as the product became better known its sale in the United States increased. In 1878 about 2,250,000 pounds of dressed haddock were smoked in Portland alone, making about 1,200,000 pounds of Finnan haddie, whereas in 1889 the five companies engaged in this business employed 48 men and utilized 3,570,000 pounds of dressed haddock, costing $71,400, which yielded 1,963,500 pounds smoked, worth $88,357 wholesale. The facilities for obtaining haddock at Boston led to the establishment of the business there in 1887, and at present the output at Boston equals that at Portland. Finnan haddie are also prepared at Eastport, Me., at New York City, and at Gloucester, Mass., where the business was established in 1893, and at St. Johns and Digby in the British Provinces. The present annual product in this country approximates 4,000,000 pounds, worth $200,000.

While the North American Provinces still receive a large part of the output, the consumption of Finnan haddie in the New England, Middle, and Central States is increasing, especially in Chicago and Cincinnati, some being sent as far as California. Formerly they were sold by the dozen, and consequently only the small fish were smoked, but at present the sales are made by weight, and haddock of all sizes are used. A singular feature in connection with the Finnan haddie trade in the winter of 1898 and 1899 was the exportation of small haddock from Boston to Digby for smoking purposes, those fish being obtainable cheaper in Boston than on the Nova Scotia coast.

To make a good product of Finnan haddie requires experience, as well as much care and attention, especially in the pickling and smoking. When received at the curing-house the fish have usually been split down the belly to the vent and eviscerated, as if prepared for the fresh-fish market. They are first beheaded and washed thoroughly with a stiff brush, all the black membrane lining the abdominal cavity being removed. They are next split down to the tail and a cut made along the right side of the backbone so that they will lie out flat, and the rough edges of the backbone are removed. They are then immersed in strong salt brine, made of Liverpool, Cadiz, or Trapani salt, for 1 or 2 hours, according to the weather and the temperature, as well as to the size and condition of the fish and the particular flavor desired, the exact length of time for pickling being learned only by experience.

On removal from the brine they are fastened to the sticks from which they are suspended in the smokehouses, the napes being stretched out flat and pierced by two small iron spikes or nails fixed in the smoke-sticks. These sticks are about 1½ or 2

HADDOCK.



FINNAN HADDIE.

inches square at the end and 4 feet long, 3 fish being usually hung from each. The sticks with the fish attached are placed on frames for a few hours to allow the moisture to dry from the fish, when they are suspended in the smokehouse, which is generally like those used in smoking herring, the sticks being placed in tiers, one above another, with space between to allow the smoke to circulate. A fire of hard wood, usually oak, is started over the floor of the smoking kiln and allowed to burn from 8 to 18 hours, when sawdust is applied, smoldering the fire and producing a dense smoke, which thoroughly impregnates the fish. In smokehouses with a low ceiling the smoking can be completed in 4 or 5 hours. In some smokehouses no wood is used, the curing being effected by burning hard-wood sawdust, rock maple or beech being preferred, and the temperature is kept as high as practicable without burning the fish, which are placed high up in the bays. The time of cooking or smoking depends on the condition of the fish, temperature of the air, and the probable time to elapse before consumption, but never exceeds one night.

When the smoking is completed the fish are removed from the smokehouse and placed on racks for cooling, and when thoroughly cooled they are packed in boxes containing from 20 to 400 pounds each, but mostly 50-pound boxes, and shipped to the trade, usually by express. Only enough are cured at a time to supply the immediate demand, as it is important that they reach the retail dealers in good condition. During warm weather they will keep only a few days, but when the weather is cool they will, under ordinary conditions, keep from 10 days to 2 or even 3 weeks. If it is desirable to keep them longer they must be smoked much harder.

The season for Finnan haddie begins in October and lasts until the following April. 100 pounds of round fish yield about 55 pounds smoked, and the wholesale price ranges from 3½ to 6 cents per pound. The choicest haddie are tender. The inside is of a light yellowish-brown or straw-color. It is alleged that some curers add saffron to the pickling brine to improve the color of the fish.

SMOKED STURGEON.

Practically all of the sturgeon flesh used in this country is smoked before going to the consumers. This is usually done in the large centers of German population, and principally in New York, Chicago, Milwaukee, Sandusky, Buffalo, and Philadelphia. The business was started in 1857 by Mr. B. K. Peebles in New York City, and reached its greatest height about 1890, the scarcity of sturgeon during recent years restricting the extent. In New York alone about 1,000,000 pounds are smoked annually, constituting over one-half of the fish smoked in that city. Along the Great Lakes the smoking of sturgeon began about 1865, these fish not being used there prior to that time. As first prepared at Sandusky and Toledo they were dressed, salted, and smoked in large strips for 8 or 10 days and sold as smoked halibut. But the smokers soon adopted methods similar to those in New York, and the business increased and was of considerable extent ten or fifteen years ago. In 1872 Mr. J. W. Milner reported to the U. S. Fish Commission that 13,800 sturgeon, averaging 50 pounds each in weight, were smoke-cured at Sandusky, and in 1880 it was found that the business had increased to 1,258,100 pounds; but the decreasing abundance of sturgeon on the lakes has resulted in a falling-off in the quantity smoked. The total annual product in the United States is now about 4,000,000 pounds, worth $720,000.

Sturgeon for smoking are received from the Delaware River and other estuaries of the Atlantic coast, from the Great Lakes, and from the Columbia River. The lake

sturgeon (*Acipenser rubicundus*) is the most desirable for smoking, the product selling in New York City for 24 or 26 cents per pound. Columbia River sturgeon ranks next, with an average value of 3 or 4 cents less than the Great Lakes. The Atlantic coast sturgeon (*Acipenser sturio*) shows yellow streaks when smoked, and the meat is also somewhat more coarse and red than the delicatessen trade desires, and sells in New York for 6 or 8 cents less than the smoked Great Lakes sturgeon, or about 16 to 20 cents per pound. The prices prevailing in New York are quoted, since that is the principal market in the country for smoked sturgeon and the choicest product is there prepared, but these prices are somewhat higher than those prevailing at other points, especially along the Great Lakes. In Chicago smoked lake sturgeon usually sells at 18 to 20 cents per pound wholesale.

In the early history of the industry the sturgeon intended for use after the fishing season was over were dressed and salted in butts or barrels, whence they were removed as required, being soaked out before smoking, as is now the case with Halifax salmon. At present, however, the surplus sturgeon are almost invariably kept frozen in cold storage until required. Before freezing, the fish are dressed, the heads, tails, viscera, fins, and backbones being removed. Practice differs in the various localities in regard to removing the skin. Until the last 6 or 8 years all sturgeon were skinned, and that is at present the common practice with the Atlantic coast fish. But about 1890 the practice of leaving the skin on was introduced along the Great Lakes, and is now general in that locality. Formerly the Columbia River sturgeon were skinned before being frozen, but at present nearly if not quite all of those placed in cold storage have the skin left on. Before freezing, the fish are usually cut into four pieces, about the size of the freezing pan, or in smaller pieces suitable for smoking, the former being more frequent. The methods of freezing and subsequent cold storage have already been described.

On removal from cold storage the fish are thawed by exposure to air of moderate temperature, being turned once or twice during the operation, or, better still, by immersing them in water of medium temperature. They are then treated exactly as though received fresh from the fishermen. They are cut into suitable chunks, 2 or 3 inches wide and weighing 1½ or 2 pounds, the width varying according to the thickness of the meat. These chunks are then brine-salted in barrels or hogshead butts, about 5 pounds of No. 2 salt to 100 pounds of fish being sprinkled among the chunks and sufficient brine of about 85° strength being added to cover the fish.

Some smokers, however, use no dry salt, depending entirely on very strong brine in which the fish remain from 6 to 16 hours, according to the temperature and strength of the brine as well as the size of the pieces. One very successful smoker uses dry salt without brine during the summer, and in the winter uses brine only of about 98° salinometer test in order to economize time, since it takes about 18 hours to strike the fish in dry-salting, whereas 10 hours are sufficient for striking in brine. In general dry-salting is preferred, since its tendency is to make the flesh harder and firmer. In some localities the trade requires very light, salted fish, and they remain in brine only 15 or 20 minutes, being stirred about during the immersion.

On removal from the pickle the pieces of flesh are strung on steel or iron rods about one-third of an inch in diameter and 3 feet long, the rod passing through the thin part of the chunk and 8 or 10 chunks being strung on each rod. They are at once dipped in fresh water to remove surplus salt, slime, etc. In some establishments the

SPLITTING HADDOCK PREPARATORY TO MAKING FINNAN HADDIE

CLEANING HADDOCK PREPARATORY TO MAKING FINNAN HADDIE.

pieces are soused in fresh water immediately on removal from the pickle. In case the fish have been salted only 15 or 20 minutes, they are not dipped or rinsed. After draining for a few moments, or, better still, drying in the open air for several hours, they are suspended in the lower part of the smokehouse from 4 to 6 feet above the fire, where they are exposed to a gentle smoke with doors open anywhere from 1 to 5 hours, according to the weather and the flavor of the product desired. When the weather is sultry it requires twice as long as when it is clear. Then the doors or dampers are closed and a hot hickory, maple, or oak fire is built and the fish cooked from 1 to 2 hours, care being taken that it does not become too hot and melt or fall from the rods. On completion of the cooking process the meat is allowed to cool, either by opening the doors of the smokehouse or by removal to the open air, when it is ready for the trade.

While the foregoing are the methods in general use, yet many smokers have special processes of their own. One of the most successful smokers on the Great Lakes operates as follows: The small pieces of flesh, 1½ to 2 pounds in weight, are first rubbed with No. 2 packers' salt and put in tight barrels with salt sprinkled among them, about 20 pounds of salt in all being used to each 100 pounds of fish. In about 7 or 8 hours, when the fish are saturated with the salt, they are removed, rinsed in two waters, strung on wire hooks, and suspended from the smoke-sticks. After draining for an hour they are placed in the smokehouse in 2 or 3 rows, 5 to 7 feet above the floor, and subjected to a hard-wood smoke for 7 or 8 hours at an even temperature.

One hundred pounds of dressed sturgeon yields from 63 to 70 pounds smoked, and the product usually keeps one or two weeks under ordinary conditions.

Notwithstanding the great scarcity of sturgeon and its consequent high price, the consumption of smoked sturgeon amounts to about 4,000,000 pounds annually.

It is not practicable to hold smoked sturgeon in cold storage, because of its tendency to mold, but it is canned to a small extent.

SMOKED CATFISH.

The increasing scarcity of sturgeon with the consequent high price has resulted in the smoking of channel catfish as a substitute. These are obtained chiefly from the Mississippi River, especially in the vicinity of Memphis, and they are smoked in Chicago, St. Louis, and the Middle Mississippi Valley. This industry is of very recent development, but as it furnishes a satisfactory substitute for sturgeon, which are becoming so costly, it will probably grow to considerable proportions.

Being intended as a substitute, the catfish are smoked in identically the same manner as are sturgeon. The fish as received at the smokehouse are usually beheaded and eviscerated. They are skinned and cut into small pieces, weighing about 1 or 1½ pounds each, and are pickled for 6 or 8 hours in tight barrels. This may be accomplished by rubbing the pieces with salt and placing them in the barrel either with dry salt scattered among them, or simply by placing them in the barrel with dry salt or with strong brine. On removal from the brine the pieces are rinsed by dipping in fresh water, to remove slime, surplus salt, etc.; they are then attached to the smoke-sticks and drained for an hour or so, and placed in the smokehouse, where they are smoked for 7 or 8 hours in the same manner as sturgeon are treated. 100 pounds of dressed catfish yield from 65 to 70 pounds smoked, and the product sells usually at about 15 or 16 cents per pound. The total annual product of smoked catfish in the United States probably does not exceed 50,000 pounds, and its sale is confined principally to those who are willing to accept a substitute because of its being cheaper.

At several points in the Mississippi Valley the small catfish are smoked whole, like lake herring. They are split to the vent and eviscerated, the head and in some instances the skin being left on, struck with salt in tight barrels, and smoked for a few hours in the manner described for lake herring. The demand is small, the business amounting probably to 10,000 or 15,000 pounds.

SMOKED EELS.

Smoking eels is one of the industries introduced into this country by German residents, and it is carried on in New York, Philadelphia, Buffalo, Sandusky, Chicago, Milwaukee, Washington, and various minor places. The product will keep only a week or two under ordinary conditions in cool weather, and the extent of the business in each locality is generally limited to the local demand.

Generally the eels are received at the smokehouse fresh, directly from the fisheries, but some are also received frozen from cold storage. In the latter case they are thawed by immersing them in water a few hours or by exposure in the open air. Some smokers "slime" the eels with salt; that is, rub the skin with a small quantity of fine salt to remove the slime therefrom. In dressing, the fish are split from the head to the vent and the viscera removed. It is desirable to continue the splitting down to the end of the tail sufficiently deep to remove the large vein along the backbone, but sometimes this may be pulled out without splitting the fish more than an inch or two beyond the vent. Few smokers, however, give attention to this item. The eels are immersed in strong brine from 1¾ to 7½ hours, according to strength of brine, size of fish, and the desired flavor. This brine should be quite strong, about 20 pounds of Liverpool or other good salt being required for each 100 pounds of fish.

In New York the eels are usually pickled for 2 hours, while on the Great Lakes the length of the time is generally about 7 hours. On removal of the fish they are washed, bristle brushes being used by some smokers, while others simply dip the fish in water for removing the slime and surplus salt. A few smokers throw them in a tub of water and beat them with a net for several minutes to accomplish the same purpose. The eels are next strung on iron or steel rods one-third inch in diameter, the rod passing through the head of each eel, or through the throat cartilage and out the mouth, and hung in the open air a few hours for drying. But if the atmosphere be moist or the saving of time necessary they may at once be placed in the smokehouse.

In New York, where small brick ovens are used, the fish are subjected to a mild smoke for about 4 or 5 hours until they have acquired the proper color, when the fires are gradually increased and they are hot-smoked or cooked for 30 or 40 minutes. At Buffalo and some of the other Great Lakes ports, the smoking is usually at an even temperature throughout and continues for 6 or 8 hours. Mahogany or cedar sawdust is used in New York for making the smoke, while hickory or white-oak wood is used for cooking, the latter being preferred. In Washington the eels are suspended in the hogshead smokehouses over a fire made of oak and hickory wood and dried for 20 minutes, when the hogshead is covered with sacking and thus hot-smoked for 3 or 4 hours, the fires being sprinkled with water from time to time to produce a hot vapor. The smoking must be carefully attended, for if the heat becomes too great the fish will curl up out of shape. A good test to determine whether the cooking is sufficient is the ease with which the skin may be separated or peeled from the flesh where the eel has been split.

The decrease in weight by dressing and smoking is about 35 per cent, 100 pounds of round eels yielding 65 to 75 pounds smoked. In New York the product sells for

PICKLING HADDOCK IN THE PREPARATION OF FINNAN HADDIE.

SMOKING FINNAN HADDIE

about 20 cents per pound, while at Buffalo and other Great Lakes points the price is usually 14 to 15 cents per pound. When eels have been pickled 6 or 8 hours they ordinarily keep 10 or 12 days; but when the salting has been only 2 hours, as is usual at New York, they are liable to mold after 5 or 6 days. Smoked eels keep a shorter length of time than almost any other smoked fish.

Eels are sometimes skinned before being smoked, the process being the same as above described, except that less salting and smoking is required, and it is also very difficult to keep them from falling down off the rods in the smokehouse.

The trade in smoked eels in New York is probably not 30 per cent of what it was 15 or 20 years ago, but along the Great Lakes it appears to be increasing. The annual product in the entire country is probably about 150,000 pounds, worth $27,000. There is some demand for smoked eels in cans, which is met by two fish-canning establishments in New York City. The smaller eels are used for this purpose, and they are smoked somewhat more than those sold to the delicatessen trade.

The following method of smoking eels prevails to some extent in northern Europe, especially in Germany:

The head, skin, tail, and viscera are removed, and the eel is split open the entire length, and the backbone and many of the smaller bones attached to it removed. It is then laid in strong salt brine, where it remains for 6 hours, and is then wiped dry with a linen towel and is covered with the following preparation, which has been pounded in a porcelain mortar: One large anchovy, 1 ounce of fine salt, 8 ounces of powdered sugar, 1 ounce of saltpeter, and sufficient butter to make a paste of the ingredients. The eel, thoroughly cured with this preparation, is rolled up tightly in the form of a disk, beginning at the tail end, tied with a cord to hold it in position, and sewed up in a linen cloth, which covers the disk and allows the end to project. These disks are next suspended in an ordinary chimney smokehouse and subjected to a strong smoke for 5 or 6 days, then allowed to cool and become firm, when they are ready for the table.

SMOKED MACKEREL.

There is a small business in smoking both fresh and salt mackerel in New York City and a few other points on the Atlantic seaboard, the output amounting to probably 8,000 pounds of the former and 35,000 pounds of the latter. The fresh mackerel are cured in very nearly the same way as lake herring, except that usually they are not split, being prepared round. The fish are first struck in brine, in which they remain for 12 or 14 hours, then removed and opened at the vent with the point of a knife to let the pickle in the abdominal cavity escape. They are next put on smoke-sticks, drained and dried for 2 or 3 hours, and placed in the smokehouse, where they are subjected to a gentle smoke for 4 to 5 hours, until properly colored, when fires are built and the fish cooked for a couple of hours, as in case of ciscoette or lake herring.

In preparing salt mackerel for smoking, the fish are cleaned and the dark stomach membrane removed, when they are soaked in fresh water for 6 to 12 hours, or in some localities from 15 to 24 hours, according to the size and the degree of saltiness. On completion of the soaking they are washed, strung on rods or smoke-sticks, drained, and hung in the upper part of the smokehouse and subjected to a gentle smoking for 5 to 15 hours at a low temperature.

No. 2 mackerel bring about 16 cents per pound and extra large smoked mackerel 20 to 30 cents per pound, but generally it is the smaller fish that are used for this purpose. The trade in these fish is very much less than formerly, the quantity used in New York City being only about one-tenth of what it was from 1880 to 1885, but the business during that period was much greater than theretofore, resulting from the salted mackerel being received at the markets in June and July instead of a couple of months later, as formerly.

SMOKED SHAD, FLOUNDERS, LAKE TROUT, CARP, ETC.

In the Chesapeake region and at various points along the coast small quantities of shad are smoked, usually in precisely the same manner as already described for river herring or alewives. Formerly many barrels of "economy shad" salted on the Kennebec River were smoked, but the demand ceased about 1880. A superior quality of smoked shad may be made by rubbing fine salt, saltpeter, and sugar or molasses over the fresh fish, and after they are struck, smoking them a few days at an even temperature. These are far superior to those prepared from salted shad.

A few flounders are smoked each year in New York and other populous centers of the Atlantic seaboard, the quantity probably amounting to about 15,000 pounds annually. The small flounders weighing half a pound or less are used, and these are eviscerated, pickled with brine in butts for about 2 hours, strung on smoke rods, drained, and cold-smoked for 8 to 10 hours. Sometimes these fish are hot-smoked for half an hour or so after the color has been set by the cold-smoking.

Menhaden and butterfish have been smoked to more or less extent during the past few years, but few are so prepared at present.

Smoked lake trout and carp are prepared to a small extent in the manner already described for lake herring or whitefish, but little demand exists for these products.

Efforts have been made to produce marketable articles of smoked hake and pollock, but the business has never assumed any commercial importance. There seems no valid reason why smoked pollock at least should not become popular, the flesh of that species seeming well suited to this method of curing. Smoked mullet is a very choice article, but practically none is prepared for the general market.

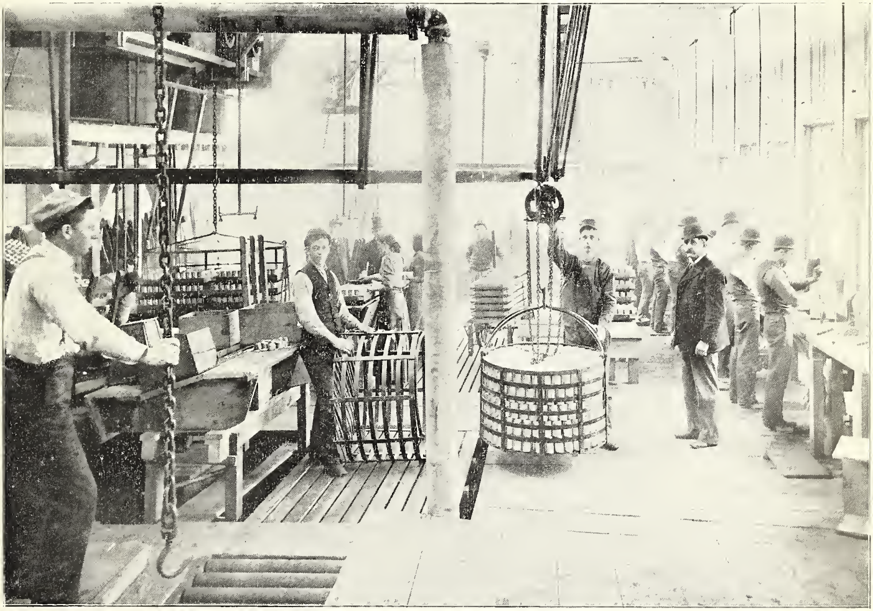
In 1885 experiments were made by the United States Fish Commission to introduce smoked kingfish, which abound off Key West. The Fish Commission report for 1885, p. LIII, states, in substance:

> These fish were prepared with much care at Gloucester, and proved to be an excellent smoked fish, being tested by many experts, some of whom pronounced them equal or even superior to smoked halibut or salmon, being free from the rather rank taste that the smoked halibut sometimes has.

Tilefish have been smoked as an experiment by several persons, but experts differ as to their qualities. The Fish Commission report for 1882, p. 247, states:

> In the summer of 1879 Capt. George Friend, of Gloucester, smoked some of the tilefish, and he, as well as several others who ate them, stated that they were excellent, rivaling smoked halibut in richness and flavor. On the other hand, Mr. William H. Wonson, 3d, does not speak so highly of its fine qualities as a food-fish under the same conditions. He says that while it is certainly very good and wholesome, as well as a desirable article of food when smoked, it can not compete with the halibut, and is no better, in fact, than smoked haddock.

INTERIOR OF BALTIMORE OYSTER-CANNING HOUSE, WASHING, ASSORTING, WEIGHING, AND PLACING OYSTERS IN CANS. (See page 517.)



CAPPING AND PROCESSING ROOM OF BALTIMORE OYSTER-CANNING HOUSE. (See page 517.)

PRESERVATION OF FISHERY PRODUCTS BY CANNING.

DEVELOPMENT AND METHODS OF CANNING.

The various processes of canning are all directed essentially (1) to preserving foods in hermetically sealed vessels from which the atmospheric air has, so far as practicable, been driven off, and (2) to destroying by heat or otherwise such germs as may be in the food before or after it is sealed up. Heat is applied to destroy the germ within the food, and the entrance of other germs or putrefactive organisms is prevented by sealing the can.

The credit for the introduction of this method of preserving foods is shared between a Mr. Soddington, who in 1807 presented a description of his process to the English Society of Arts, under the title "A method of preserving fruits without sugar, for house or sea stores,"* and François Appert, who in 1810 published a book giving directions for a process for which he was awarded a prize of 12,000 francs offered in the preceding year by the French Government for a method of preserving perishable alimentary substances. The methods of Soddington and of Appert were essentially the same, and as follows: Glass bottles were filled almost to the top with the food, which in some cases was partly cooked, the bottles corked loosely and placed up to their necks in tepid water, the heat being gradually raised to a temperature between 170° and 190° F., and being maintained there for a period varying from 30 to 60 minutes. The bottles were then corked securely and allowed to cool slowly in the bath. In some cases Soddington filled the bottles with boiling water before sealing, and he recommended further that the corks be covered and the bottles laid upon their sides, so that the hot liquid might swell the corks Based on the erroneous impression that exhaustion of the air is the essential feature of preserving foods, a number of methods were soon after and have until quite recently been devised for accomplishing the result. Among these methods are the use of air pumps, introducing carbonic acid or hydrocarbon gas into the vessel containing the food, etc.; but none of them have come into general use.

This general process of preservation does not appear to have been very extensively employed until the substitution of tin cans in place of glass bottles. These seem to have been used first in 1820; and in 1823 a patent for them was issued to Pierre Antoine Angilbert.† Preserved fish had been placed in tin cans for many years previous, but not in the manner known at present as canning.

In "A treatise on fishing for herring, cod, and salmon, and of curing or preserving them," published in Dublin in 1800, the following method of preserving salmon is noted as being practiced in Holland:

> As soon as the fish is caught they cut off the end of the snout [head] and hang it up by the tail to let the blood flow out as much as possible. A short time after they open its belly and empty it and wash it carefully. Then they boil it whole in a brine of white salt, often skimmed. Before it is quite

* Hassell: Food and its Adulterations, London, 1855, 432.
† Letheby: Chemical News (American reprint), 1869, 4, 74.

boiled they take it out of the brine and are careful not to injure the skin, after which they let it cool and drip on a hurdle. Then they expose it for a day or two to the smoke of a fire made of juniper, which must make no flame. Finally, they put it into a tin box, the sides of which must be an inch higher than the thickness of the fish, and fill up the box with fresh butter, salted and melted. When the butter is coagulated they put on the cover and solder it to the lower part of the box. Some persons eat the fish without boiling it again, but it is better when it gets a second boiling. In winter good oil of olives may be used instead of butter.

Angilbert's method was very similar to the present processes, which differ in some minor features, but are uniform in principle. A definite amount of the article to be preserved, with some liquid, is placed in a tin can, over which the cover, containing a minute hole, is soldered, and the can and contents are placed in a bath of boiling water. Through the small hole the air and steam escape from the can in boiling, and the heat also kills the bacteria. The hole is closed with a drop of solder, and the process of cooking is completed.

A number of modifications and improvements have been adopted, principally in reference to shortening the time of cooking, permitting the heated air in the can to escape, softening the bones of small fish, filling and handling the cans, etc.

While it is necessary that the fish be thoroughly cooked, yet in a majority of cases it is equally important that they remain as short a time as practicable under the action of the heat. This is facilitated by increasing the temperature of the boiling water. Formerly the cans of fish were boiled in salt water, by which a temperature of 230° F. is attainable, or in water containing chloride of calcium, or sulphide of soda, whereby 250° F. may be secured. But these agents are each prejudicial to the metal of the can and the kettle, causing them to rust or wear rapidly, and by using the maximum of heat secured by the chloride of calcium process the cans often burst, with dangerous effects to the workmen. About 1874, steam-tight cylinders were introduced, in which the cans are subjected to a very high temperature by introducing steam from adjacent boilers, thus shortening the time of exposure to heat and removing liability to burst, the outward pressure in the can being counterbalanced by the inward pressure of the steam in the cylinder. This was first applied in 1874 in canning oysters. At first steam only was used, but it was soon found that the contact of the steam with the can results, to some extent, in scorching the contents that lie next to the inner surface of the can, and the oysters or fish have a slightly burnt flavor in consequence, the can itself also exhibiting a bluish color on the inside. This was remedied by placing the cans in water, below the surface of which the superheated steam is admitted. The pressure upon the intermediate water is transmitted to the outside of the can and counterbalances the pressure from the inside until the cooking has been completed. The fish or oysters on the inside of the can are also acted upon uniformly by the heat, and neither cans nor contents injured, even if the temperature be raised to 250° F. or more. By this process, which has been generally adopted, the cooking is done in much shorter time and at greatly reduced expense.

To remove the air from the can it was formerly customary to leave a minute hole in the lid, heat the can and contents by nearly submerging the can in boiling water, and then solder the small hole. At present the cans are hermetically sealed and boiled, then punctured to permit the expanded air to escape, when they are resealed, and the process of cooking completed. An improved method has been devised, in which the air is extracted from the can by means of tubes connecting the tin with a vacuum chamber, but it is little used in canning fishery products.

An objection to the canning of small fish is the large number of bones. Ordinarily the heat developed in the process of canning destroys the cohesion of the particles of the bones, so that they may be masticated and swallowed without inconvenience, but the bones of some small fish are not so easily softened. About 1867 it was found that by placing the fish in vinegar and subjecting them to a temperature of 170° F. for several hours, according to the size of the bones, the acid of the vinegar dissolves the lime salts contained in them. This process is somewhat costly and the vinegar is objectionable to some consumers.

In 1872 it was found that the bones could be softened without using vinegar, by successive steamings for several hours, with an intervening cooling. A patent for this process was issued May 21, 1872, to Isaac L. Stanly, of New York City, who thus describes the process with special reference to canning menhaden:

First put the fish, after being dressed and prepared, into open tin or other suitable boxes or vessels, and place the same in a steam chest, which is afterwards closed. In this condition steam the fish with steam of 212° F., or thereabout, for 5 hours, more or less, after which they are taken out of the steam chest and put on tables to cool and drain for about 5 or 6 hours. The fish are then packed in tin boxes filled with olive or other oil, and the boxes afterwards closed and the covers soldered or sealed. Said boxes containing the fish are next put into a tank or chest, which is afterwards closed, and heated by steam or otherwise to a temperature of from 217° to 220° F., or thereabout, for a period of from 2 to 5 hours, according to the size of the fish or its bones.

An objection to the use of tin cans in preserving food products is the liability of the lead in the can to affect and taint the contents, which sometimes results in lead poisoning. This danger is not great when good materials are used in making the cans, except when they are filled with such articles as shrimp, the acid in which acts upon the tin. This is remedied by introducing a lining between the inner surface of the can and its contents. This lining may be textile fabric or a coating of asphaltum cement. Silver plating has been employed, and a lining of selected corn husks has also been used to a limited extent. For an account of these methods see pp. 523 et seq.

The most satisfactory way of overcoming this liability to lead poisoning is by using cans sealed without the use of solder. There are several varieties of these cans on the market at present, the joints being made tight by introducing a gasket or washer of rubber, paper or similar material between the overlapping tin and crimping or folding the edges so as to hold them together. Some of these cans are drawn by machinery out of one solid piece of tin plate, and others have an outside soldered seam in the body only. The additional cost of these cans has confined their use to the preservation of the more costly varieties of marine products.

A great improvement in canning was the introduction, about 25 years ago, of the use of solder in the form of twisted strands cut into rings of the proper size and containing on its surface the proper quantity of flux. By twisting a strand, or by uniting two or more strands into a cord, the exterior will contain a multitude of small depressions. The wire is converted into rings by winding it on a wooden cylinder of the required diameter, a cut is made through the wire the whole length of the cylinder, and the rings are slipped off. The rings are coated with resin or other suitable flux, the depressions become filled with it and hold a sufficient quantity for soldering purposes. This quantity is regulated by the method of twisting the wire or the manner of applying the flux. If to be used for square tops, the wire is wound on a rectangular block of the required size and then cut. It is apparent that when these rings are applied to the capping of tin cans no more solder or resin need be used

than is actually necessary to solder on the cap, saving a large quantity of material over the old method of using bar solder and avoiding smearing the top of the can.

In 1879 Charles C. Lane, of New Westminster, British Columbia, introduced an improvement in cans, conforming to the natural shape of the fish, to avoid cutting it into small pieces. The can is in two parts, approximating respectively the shape of the two halves of the fish divided transversely to its length, and is so fitted that it may be adjusted longitudinally to the length of the fish, one half being somewhat smaller than the other at the open end, so that it will fit into the other. The patentee thus describes his invention; the claim relates especially to the method of constructing the pieces forming the can, so as to avoid waste and reduce the amount of soldering to a minimum:

The can is made in two parts, one part being somewhat smaller than the other at the open end, so that it will fit into the other. Each of these parts is made in two pieces, the pieces being stamped out of sheet metal and soldered at the joints or meeting longitudinal edges. These halves of the ends have each stamped in them a recess or flattened portion, which admit of a certain expansion during the boiling process, and of contraction when the air is blown off and the can and contents are finally cooled. This flattened portion or recess formed in these pieces makes a flat place on the outside and facilitates packing of the cans or storing on the shelves of the dealers in good order. When lying on either side the can rests on these flat parts, and they may be placed one above another without sliding about on account of the irregularity of their general shape.

Each can is formed of four pieces, two of which are stamped out to be approximately of the form of the head and shoulders of a fish, while the other two are shaped to fit the tail half of the fish. These are got out in quantities, and the two halves of each part are united, and the longitudinal seam is soldered by the aid of the mechanical bath, which is easily accomplished when the can is empty. This enables me to do the largest portion of the work of can-making, including the long side seam or joint, mechanically, with but little hard labor, and during the idle season and before the fish commence running. When the two halves are thus made ready to receive the fish it will be seen that the surrounding transverse joint is all that is left to be done, and this renders the labor to be performed in the actual canning so slight that the fish may be put up in this manner to compete with any other form of canning.

After the separate ends are made in the manner described the fish is placed in the open end of one in the proper position, and the other half is placed over the other end of the fish. The two open ends thus come together, the smaller slipping inside the larger. At this central joint I place a V-shaped piece or strip of a soldering metal, which fits between the two parts to form the transverse joint in the final soldering, both by filling it up and by partially melting.

As the fish vary somewhat in size, it will be seen that the parts must be telescoped or pushed together until they fit the fish snugly before the transverse or central joint is soldered. This will insure a perfect fit to every fish, and will prevent it from sliding about in the can.

By making the can in this manner small sheets of tin may be used with very little waste in cutting, and at the same time cans can be made which will correspond to the size and shape of the fish. It will be manifest that either of the halves may be sealed up independently of the other by simply fitting a flat head or cover to the large, open end and soldering it in place after the can is filled.*

Among the devices contrived during the last fifteen years to facilitate the canning process, machines for filling the cans are numerous. But these have not been so generally adopted in the canning of fish as in preserving vegetable products, the fish in hand-filled cans presenting a neater appearance than those filled by machinery. However, on account of the great saving of labor, they are used in a number of salmon canneries of the Pacific coast.

One of the first of these, invented† in 1880 by A. H. Moore, of Ellensburg, Oreg., is so arranged that the fish, after being cut up in suitably sized pieces, is placed in a

*Letters Patent No. 221325, November 4, 1879. †Letters Patent No. 227283, May 4, 1880.

hopper and forced or fed by a plunger into a mold corresponding in size to the can. A knife then cuts off the mass, and another plunger forces the mass of fish from the mold into the can, which is then removed and sealed. The principal objection to this is that the portion of fish is not properly shaped to fit the can, being left flat on one side and great pressure has to be exerted to force the fish into the mold.

During the same year an improvement on this process was invented* by Robert D. Hume, the well-known salmon-canner of the Pacific coast. This improvement consists in the employment of a carrying belt operated by an automatic pawl and ratchet, whereby the material is carried forward into a chute, through which it is led into a shaping and compressing cylinder. In combination with this chute there is employed a pair of slim cylindrical shearing knives, arranged to rotate about a longitudinal axis, one within the other, in concentric circles, which cut the material to the exact cylindrical shape necessary to fill the can without unequal compression.

Numerous other can-filling machines have been invented, for a description of which see the following letters patent:

Patent No.	Date.	In favor of—	Patent No.	Date.	In favor of—
259442	June 13, 1882	Wm. West, Keene, Canada.	356122	Jan. 18, 1887	John B. Hodapp, Mankato, Minn.
262575	Aug. 15, 1882	Augustine Crosby, Benton, Me.	358498	Mar. 1, 1887	H. R. Stickney, Portland, Me.
291799	Jan. 8, 1884	J. Stevens, Woodstown, N. J.	360541	Apr. 5, 1887	Do.
297549	Apr. 29, 1884	Geo. Ackermann, Cincinnati, Ohio.	361177	Apr. 12, 1887	G. L. Merrill, Syracuse, N. Y.
301897	July 15, 1884	Edmund Jordan, Brooklyn, N. Y.	372876	Nov. 8, 1887	H. R. Stickney, Portland, Me.
304063	Aug. 26, 1884	Volney Barker, Portland, Me.	373306	Nov. 15, 1887	D. D. Ranney, Lewistown, Ill.
306658	Oct. 14, 1884	J. Stevens, Woodstown, N. J.			

The preservation of foods by the canning process has now become one of the world's great industries, it being applied to alimentary substances of almost every description, and the product is of enormous extent. It was early used in the preservation of sardines, lobsters, etc. In 1824 John Moir & Son, of Aberdeen, Scotland, began the canning of salmon, game, and other meats.

Canning was first employed on the American continent by Charles Mitchell, at Halifax, Nova Scotia, in 1841, and in 1842 by U. S. Treat at Eastport, Me. The canning of oysters was commenced about 1844; Pacific coast salmon were canned first in 1866, and the preparation of sardines in this country dates from 1875. Yet at present the total value of the domestic output of these three products as canned approximates $15,000,000 annually.

There are five general classes of canned marine products—viz, (1) plain-boiled, steamed, or otherwise cooked; (2) preserved in oil; (3) prepared with vinegar, sauces, spices, jellies, etc.; (4) cooked with vegetables, etc., and (5) preserved by some other process, but placed in cans for convenience of marketing.

The first class includes salmon, mackerel, herring, menhaden, cod, halibut, smelt, oysters, clams, lobsters, crabs, shrimp, green turtle, etc.

Sardines almost exclusively make up the second class.

The third class includes various forms of herring prepared as "brook trout," "ocean trout," etc., mackerel, eels, sturgeon, oysters, lobsters, crabs, etc.

The fourth class comprises fish chowder, clam chowder, codfish balls, green-turtle stew, terrapin stew, and deviled crabs.

The fifth class is made up of (*a*) smoked herring, halibut, haddock, carp, pickerel, lake trout, salmon, eels, sturgeon, etc., and (*b*) brine-salted mackerel, cod, and caviar.

* Letters Patent No. 233449, dated October 19, 1880.

CANNING SALMON.

The canning of salmon appears to have originated at Aberdeen, Scotland, in 1824; but prior to the establishment of salmon canneries in the United States, in 1864, the application of the process to this fish was very limited. During the last 30 years this industry has been confined to the western coast of the North American continent and to certain Asiatic countries bordering the Pacific coast. It has become one of the great fishery industries of the world, the annual output exceeding $10,000,000 in value, over 99 per cent being prepared on the American continent.

On the western coast of the United States the industry was begun in 1864 by Messrs. Hapgood, Hume & Co., at Washington, on the Sacramento River. A member of this firm had been engaged in canning lobsters in New Brunswick, on the shore of the Bay of Chaleur, and methods somewhat similar were applied to the canning of salmon. The machinery and appliances were very crude as compared with modern devices. The fish, cut into transverse sections of suitable lengths, were placed in the cans and the cover attached, with ventholes open. The cans were then nearly submerged in fresh water contained in large round-bottomed iron kettles and boiled for an hour, after which they were removed and the vent closed. They were next placed without arrangement in an iron bath kettle containing salt water heated to a temperature generally from 228° to 230° F. After an hour's bath the cans were removed and placed in a tank of cold water. When cooled they were wiped off, the ends painted with red lead, the sides labeled, and the cans packed in the cases. No process was employed for testing for leaks, and consequently about one-half of the product of the first year spoiled.* Much difficulty was experienced in placing the canned salmon on the San Francisco market, but eventually the entire pack was sent in separate lots to Australia, where it netted $16 per case to the shippers.†

The trade gradually increased from year to year with the improved transportation facilities and the development of markets for the product. In 1866 the first Columbia River cannery was established at Eagle Cliff, about 40 miles above Astoria. In 1874 canning was begun in British Columbia, and in 1882 Alaska began to make a showing. The total pack on the west coast of North America in 1892 was 1,323,000 cases of 48 1-pound cans each, approximating in value $6,549,000; and in 1895 it was 2,175,986 cases, worth $10,081,997 at first hands.

During the first years of the trade South America and Australia furnished the consumers of the canned salmon, but as the output increased an English market was sought. The latter did not at first take kindly to the American product, but after persistent efforts on the part of some of the most extensive London wholesale dealers the article became better known and the people of Great Britain soon became the principal consumers, sometimes using 500,000 cases in a single year.

Several species of salmon are utilized in the canneries of the west coast, the principal ones being chinook or quinnat salmon (*Oncorhynchus tschawytscha*), blueback salmon or redfish (*O. nerka*), silver salmon (*O. kisutch*), steelhead (*Salmo gairdneri*), dog salmon (*O. keta*), and humpback (*O. gorbuscha*).

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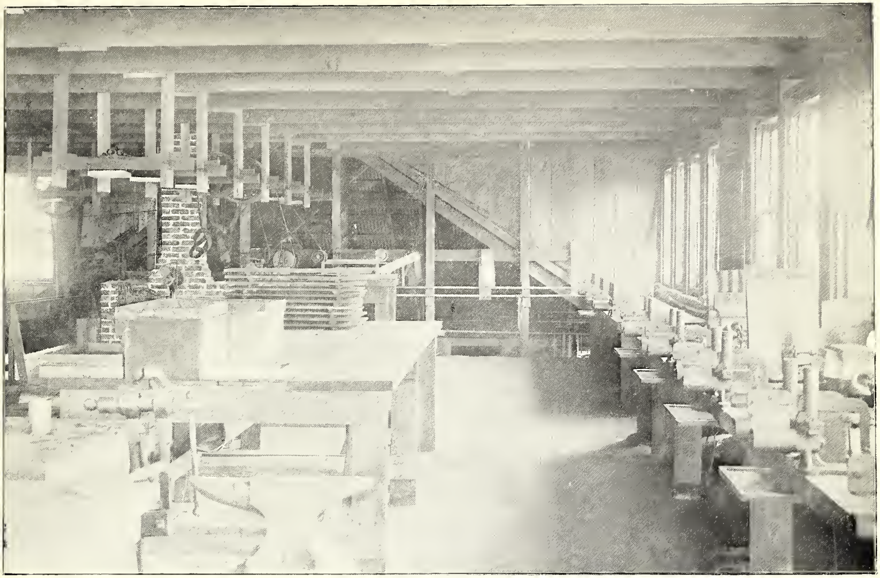
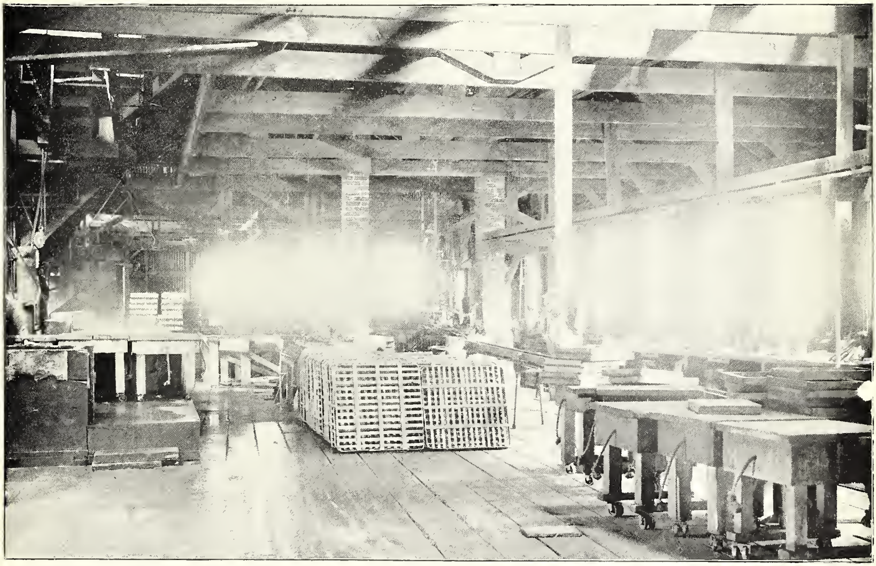
* Hume's Salmon of the Pacific Coast, p. 8.

† Report U. S. Fish Commission, 1888, pp. 167, 168.





SALMON CANNERY, FRIDAY HARBOR, WASHINGTON. UPPER VIEW SHOWS ROOM WHERE CANS ARE MADE; LOWER VIEW SHOWS RETORT ROOM.

The following summary shows the number of cases of each species canned on the Pacific coast during the four years ending in 1895:

States.	Chinook.	Blue-back.	Silver.	Steel head.	Dog.	Hump-back.	Total.
1892—Washington	134, 253	19, 441	28, 708	26, 945	29, 411		238, 758
Oregon	237, 684	51, 106	60, 293	45, 403			394, 486
California	14, 334		1, 550				15, 884
Total	386, 271	70, 547	90, 551	72, 348	29, 411		649, 128
1893—Washington	129, 078	55, 237	31, 707	25, 663	23, 480	17, 530	282, 695
Oregon	176, 024	23, 074	62, 913	39, 563	9, 230		310, 804
California	26, 436		500				26, 936
Total	331, 538	78, 311	95, 120	65, 226	32, 710	17, 530	620, 435
1894—Washington	156, 549	53, 717	32, 118	23, 209	33, 952	9, 049	308, 594
Oregon	216, 507	25, 523	100, 087	38, 829	3, 162		384, 108
California	31, 663		500				32, 163
Total	404, 719	79, 240	132, 705	62, 038	37, 114	9, 049	724, 865
1895—Washington	157, 187	70, 304	81, 957	18, 985	48, 686	23, 633	400, 752
Oregon	316, 284	12, 854	138, 981	30, 693	27, 027		525, 839
California	28, 635		400				29, 035
Total	502, 106	83, 158	221, 338	49, 678	75, 713	23, 633	955, 626

NOTE.—468,970 cases of salmon were packed in Alaska in 1892 and 619,379 cases in 1895, making the total pack for the United States in 1892 1,118,098 cases, and in 1895 1,575,005 cases.

The extent of the salmon-canning industry of the Pacific States in 1895 is shown in the following table:

States.	Persons em-ployed.	No. of can-neries.	Value.	Cash capital.	Total in-vestment.	Salmon utilized.		Salmon canned.	
						Lbs.	Value.	Cases.	Value.
California	198	4	$62, 000	$64, 000	$126, 000	1, 906, 525	$52, 591	29, 035	$128, 632
Oregon	1, 960	26	719, 225	942, 500	1, 661, 725	35, 299, 241	1, 184, 529	525, 839	2, 456, 698
Washington	1, 146	17	374, 650	601, 000	975, 650	27, 441, 724	731, 522	400, 752	1, 638, 938
Total	3, 304	47	1, 155, 875	1, 607, 500	2, 763, 375	64, 647, 490	1, 968, 642	955, 626	4, 224, 268

In Japan about 200,000 cans of salmon (*Oncorhynchus perryii* and *O. haberi*), amounting in value to 24,000 yen ($12,000), are prepared annually, principally at Hokkaido and by the Sumitara and Fujino Company.

The following description of the methods of salmon canning is from Mr. W. A. Wilcox's "Notes on the Fisheries of the Pacific coast," (U. S. Fish Commission Report for 1896, pp. 583–587):

As at present conducted there is but slight difference in the manner of preparing canned salmon in any of the canneries. As a rule the factories are located adjacent to or very near the fishing-grounds, so that at the most but a few hours elapse from the time the fish are freely swimming until they are caught, delivered at the cannery, dressed, canned, cooked, and packed, thus insuring a perfectly fresh product, old or stale fish never being met with at a salmon cannery. The neatness and cleanliness of the canneries is one of the first things noticed by visitors during the packing season.

The notes here presented on the methods of salmon canning were taken in 1896 at a cannery on the Columbia River, and with few exceptions represent the canneries of the entire west coast.

The buildings connected with a salmon cannery are always built at the water's edge or partly over the water, so that vessels or boats may come alongside and deliver their fish and supplies or receive the packed products. As a rule they are large, roomy, one-story frame structures, the business of receiving, cooking, and packing of salmon all being in the one large, high, and well-lighted room. The lofts are used for the storage of empty packing-cases, empty cans, nets, etc., and in some instances large rooms are there used for the manufacture of cans. Adjacent to the cannery are the rude quarters in which the Chinese employees live and near by is usually the home of the superintendent.

Chinese have a monopoly in the canning of salmon, but never engage in their capture. Before the season opens contracts are made with some large Chinese firm of San Francisco or Portland to do the work so far as relates to receiving raw products and turning the same over canned, packed, and ready for shipment.

As a rule the fish are bought from the fishermen at so much apiece or per pound, a price for the season having previously been agreed on; but in some cases the fishermen are hired by the month, with or without board, the fishing boats and nets in that event being furnished by the cannery.

Contracts with the Chinese usually call for the packing of at least a certain number of cases, of 48 pounds each, at prices ranging from 30 to 40 cents a case for 1-pound cans, and higher for half-pound oval or other special cans.

A working gang of from 30 to 75 Chinese, in charge of a native expert foreman, is sent to the cannery in advance of the opening of the season. The men are constantly under the orders of the Chinese foreman, and he in turn is under the supervision of the superintendent. The foreman divides up the duties, assigning a gang for each part of the work from the time the fish are landed until they are cased for shipment. These gangs follow their particular part of the work all through the season, only in exceptional cases being called to any branch except their own. The receiving and dressing gang, being the first to begin, are the first to finish their labor, while the packers are the last to begin and end the work of the day. If fish are plentiful, all of the men work from about 7 a. m. to 6 p. m., with only a stop for the midday meal. If salmon are scarce, the men may have but a few hours' work.

On the completion of the work of any gang the men must before leaving thoroughly clean their section. In doing so a hose is used, with abundance of water, brooms, and scrubbing brushes, and when the day's work is over the interior, platforms, and wharves are left scrupulously clean and ready for the work of the following day.

As the fishermen arrive their catch is thrown out on the wharf, where it is received by the Chinese and carried inside the cannery and thrown into boxes on the scales. Having been weighed, a receipt is given to the fishermen, and the fish begin their journey through the cannery, that only ends after they have been canned, cooked, packed, and cased ready for shipment.

From the weighing scales the fish are thrown out on the floor and receive their first washing from a stream of water that is played on them from a hose, the fish being turned over with a pitchfork, as may be necessary, to thoroughly remove all gurry and dirt. In some instances, where fish are received faster than they can be immediately handled, they are kept cool and fresh by having, as needed, a fine spray of ice-cold water thrown over them from an overhead revolving pipe. The first gang receives the fish on the dressing tables, which are near the door. Here the first of the work begins, and to follow it through from its entrance to its exit, canned and cased, is an interesting sight to thousands of visitors during the packing season. The first operator seizes fish after fish, and with a few quick strokes of a large butcher knife severs head, fins, and tail. The next man opens the fish, removes the viscera, and scrapes the carcass inside and out. Through an opening in the floor all offal and waste are at once thrown into the river and quickly consumed by schools of scavenger fish or the large number of gulls that hover in the vicinity waiting for their food. At some of the canneries near Astoria receptacles for waste are provided by those interested in oil and fertilizer factories.

The fish is then shoved along to the man standing by the side of the header and cleaner for the next washing, and at the same time is scraped with a knife that removes the scales. The fish is then passed along into a second tank of clear water, where it receives its final washing and cleaning and is made ready for cutting in proper-sized pieces. A series of semicircular knife-blades is attached to a roller, the blades being equal distances apart, corresponding with the size or depth of cans to be filled. One end of the roller is hinged, to the other end a handle is attached. The knives are raised by means of the handle, the fish is placed under them, and with one quick, sharp blow the fish is entirely cut up into lengths suitable for canning. For 1-pound tall cans, 7 knives are attached to the roller; for 1-pound flat cans, 13 knives; for $\frac{1}{2}$-pound cans, 17 knives. The fish are now in suitable lengths, but must be sliced into sizes proper to enter the cans. This is quickly performed, and the pieces are passed on to the filling gang.

Several men stand at one or both sides of the filling table, each supplied with small scales adjusted to the weight of the cans to be filled. In some canneries cans are filled by machinery, but this is usually done by hand. As soon as filled the can is placed on the scale. If it shows full or over weight it is passed on, no fish being removed; but if short weight, the can is put one side to receive enough to make up the deficiency.

SALMON CANNERY AT KARLUK, ALASKA. SEINING ON KARLUK BEACH.

From the filler the can passes to a man who places it on a swiftly revolving plate having a closely fitting cap, and a small but strong stream of water is made to play against the revolving can, removing all grease and dirt. A small scrap of flat tin is put on top of its contents, and the prepared top is fitted on. In order to keep the top in place pending soldering, the can next goes to a man who places it on a revolving plate, while, by means of a lever operated with his foot, the top piece is forced down and securely held at the same time the edges are being smoothly crimped. The sealing of the top is ingeniously accomplished. A brick furnace has on its top a long V-shaped trough that is kept filled with molten solder. At the upper end of the solder trough and a few inches higher is a similar one filled with muriatic acid. From the crimping machine the cans drop in an almost continuous stream into the trough with acid. A heavy endless chain passes along just over the troughs, and by the friction from the chain the cans are carried on first through the acid, which touches only the outer edge of the top of the can and prepares it to receive the solder through which it next passes. The top of each can has a small hole punched in it to permit the escape of air as the can becomes heated in its passage through the trough of molten solder. Here may be noticed the utility of the small piece of tin before mentioned as being put in the can, without which the hole is liable to be clogged up with fish, and, the vent being closed, the cans are liable to be badly strained, made leaky, and have the entire top blown out.

The endless chain, having rolled the cans through the solder, drops them on an inclined plane some 30 or 40 feet in length. Shortly before reaching the bottom of this incline the cans are met with a shower bath of cold water from perforated pipes alongside of the incline. The bath is simply to cool them so that they can be instantly handled. The cans are at once placed on iron trays, known as coolers; they consist of an iron frame 35 inches square, 3 inches deep, with slatted iron bottom. One cooler holds 86 one-pound flat cans, or 160 one-pound tall cans. The small venthole on top of the can is next sealed. The cooler filled with cans is then attached to an overhead rail track and transferred to a large wooden vat filled with water, having a temperature of 212° F. The cans remain in this bath only a few moments, which is ample time to test them for leaks. If a can is not perfectly air-tight, this fact is at once made evident by small air bubbles rising from the can while in the bath, and it is at once removed for repairs, another can being substituted. When the test is completed, the cooler is placed on a small iron-framed car having a capacity of 8 coolers, one on top of another. The cans are now ready for the cooking of the salmon in large retorts.

Retorts are made of wood or iron, but are usually of boiler iron, have a round shape, and are about 13 feet long and 5 feet in diameter. A steam pipe extends along near the bottom. This is perforated for the escape of steam, which passes through a small amount of water with which the pipe is covered. On an iron track just over the pipes the loaded cars are run. Retorts usually have an opening or door at only one end, but in the cannery now being described there was an opening at each end and two retorts were used, the few feet separating them being connected by a track by which cars of coolers having passed through the first retort can pass on into the second. Each retort has a capacity of 4 cars, or 3,200 one-pound tall cans or 2,952 one-pound flat cans. Cans of salmon remain in the first retort under a steam temperature of 230° for one hour. They are then run out, vented, and at once resealed. As the top of each can is perforated with a small, sharp-pointed iron, the heated air or steam is expelled, and before its place can be taken with cold air the vent is closed by a drop of solder. and the can may be said to be free of air and air-tight. The cans are now ready for another cooking in the second retort. Here the temperature is 240°, in which one-pound tall cans remain 1 hour and flat cans $1\frac{1}{4}$ hours. Retorts are under a steam pressure of 7 to 10 pounds to the square inch.

On removing the cans from the retorts they have a stream of cold water thrown on them, by which they are cooled and cleaned. They are now finally tested for leaks or imperfections by tapping each can on the top with a small piece of iron, an experienced ear quickly detecting by sound any imperfection. Imperfect cans are replaced by others, and the cans pass on to be lacquered, labeled, and packed in boxes, each holding 48 one-pound cans or 24 two-pound cans. They are then ready for a distribution that reaches almost every portion of the civilized globe.

The cannery at which these notes were taken was provided with electric lights and ample steam power; the rooms were well ventilated and lighted; its walls were white with paint or whitewash. It is located on the Columbia River with the Cascade Range of mountains towering from 1,500 to 2,500 feet just at its back. From these mountains the icy-cold and very pure water used at the cannery is brought.

Much attention is given to variety and styles in cans and labels, which yearly show improvement in style and design. Sixteen varieties of cans were used in the pack of 1895. Brands also receive much consideration, and in many cases have a high value on account of the enviable reputation of the goods previously packed under them.

To supply the annual demand for 60,000,000 to 80,000,000 tin cans in which to pack the salmon caught in the waters of the United States on the Pacific Coast is of itself a large business. Many packing firms make a part or all of the cans they need. This is more for the purpose of keeping desirable men employed between seasons than for any saving in expenses for cans. The bulk of the cans are turned out from factories at San Francisco. In April, 1893, the Pacific Can Company of San Francisco, by opening a branch factory at Astoria, filled a long-felt want of the packers in Oregon and Washington. For ten months in the year this Astoria branch gives employment to 80 persons, of whom 25 are females and 55 males. Chinese are not employed in this establishment. The weekly pay roll averages $750, or $30,000 a year. The plant represents an investment of $80,000.

Of late each year finds some new shape or size of can used in salmon packing, there being 16 varieties of cans for salmon manufactured by this company in 1895. The total number of cans turned out in 1895 amounted to 18,500,000, of which 2,000,000 had the key attachment, on which the royalty is 75 cents per 1,000 cans. A large quantity of the various cans is kept on hand, from which the canneries of the Columbia and coast rivers and those of Puget Sound are supplied as needed. The tin plate used amounted to 45,000 boxes, of which 10,000 were of American manufacture and 35,000 were imported. The average price of plate during 1895, including an import duty of $1.20 a box, was $4.10 a box, averaging 100 pounds with 112 sheets each. American-made plate is 50 cents a box lower at Chicago than that imported, but 50 cents higher by the time it reaches Astoria, owing to the difference in freight—by sailing vessel from Europe of $7 a ton, or by rail from the East of $14 a ton.

Commander Jefferson F. Moser, U. S. Navy, commanding the U. S. Fish Commission steamer *Albatross*, has given a description of the processes of canning salmon in Alaska, in the Fish Commission Bulletin for 1898, pages 22–34.

CANNING OYSTERS.

Preserving oysters by cooking and hermetically sealing them originated in the United States in 1844, in the establishment of Thomas Kensett, Baltimore, Md., but the trade appears to have been developed by A. Field & Co. of that city. From the beginning of the industry up to the present time it has been prosecuted mainly at Baltimore, probably not 3 per cent of the total product since 1844 having been prepared outside of that city. In addition to Baltimore, oysters are canned at one or two other Chesapeake ports and at Apalachicola, Fla., Biloxi and Bay St. Louis, Miss., and Morgan City, La. The term "cove" is sometimes applied to oysters prepared in this manner, and the higher prices prevailing in the fresh-oyster trade usually require that the medium and small-size oysters be used.

Originally in the canning business the raw oysters were opened by hand, but about 1858 Lew McMurry, of Baltimore, began scalding them, this process causing the shells to open and allowing the oysters to be removed with far less labor than would be required if they had not been heated. Steaming originated about 1860, the oysters being placed in baskets holding about 3 pecks each, and these to the number of about 300 were placed in a large box and there steamed. In 1862 Henry Evans, of Baltimore, devised the present method of using, in combination with the steam box, large cars, in which the oysters are placed.* The sides and bottoms of these cars are made of iron bars, so that the steam may readily pass among the oysters, partly

* See Letters Patent No. 35511, dated June 10, 1862.

cooking them and causing the shells to open freely. The track on which the cars run is laid from the wharf to and into the steam box, and thence to the shucking room.

The details of the present process of steaming and canning follow, this description applying especially to the business at Baltimore.

The oysters when taken from the vessels are placed in cars of iron framework, 6 or 8 feet long, with capacity for about 20 bushels. These cars are run on a light iron track, which is laid from the wharf through a steam-tight chest or box, to the shucking shed. This steam chest is a rectangular oak box, 15 to 20 feet long, lined with sheet iron, fitted with appliances for turning on steam to any desired pressure, and with a door at either end which shuts closely and is so packed with felt or some other material as to make the joint between the door and box as nearly steamtight as practicable. When a car is filled with oysters in the shell it is run into the steam chest and there left for 15 minutes, with the doors closed and steam admitted. The chest is then opened and the car run into the shucking room, its place in the chest being immediately occupied by another car. By having a sufficient number of cars the laborers may be constantly employed, loading and unloading in succession as they are steamed and emptied.

In the shucking sheds the cars are surrounded by the shuckers, sometimes to the number of several hundred, each provided with a knife and a can arranged so as to hook to the upper bar of the iron framework of the car. The steaming causes the oyster shells to open more or less widely, and the meat is readily removed.

The opened oysters are then washed thoroughly in cold water and transferred to the "fillers' table," and the cans, when filled, after being weighed individually, are taken to the soldering table and there "capped"; that is, hermetically sealed. From the "cappers" they are placed in a cylindrical crate or basket and lowered into a large cylindrical kettle, called the "process kettle" or "retort," which is partly filled with water, where they are again steamed to such a degree as to destroy all germs of fermentation. After this they are placed, crate and all, in a vat of cold water, this serving the double purpose of arresting the operation of cooking by cooling them and of testing for leaks. When sufficiently cool to be handled the cans are transferred to another department, labeled, and packed in boxes for shipment.

The shuckers usually work in gangs of 6 or 8 persons, comprising sometimes whole families of men, women, and children. Those in Baltimore number about 4,000, ranging in ages from 12 to 60 years, and are mostly women and children, the work being light and peculiarly adapted to them. They are mainly of foreign parentage. Few scenes are more interesting than those observed on a visit to the shucking room of any one of the large canning houses. At one end the cars of steaming hot oysters are received, and as these are arranged in long rows covering the length of the room the shuckers, numbering 600 or more in some establishments, surround the cars and with rapidly working knives hastily and skillfully remove the yet steaming oysters. These employees are extremely industrious, and hundreds of small dwelling houses have been purchased in Baltimore with money obtained by the women and children at work in the oyster houses. The shucking is done in a cup known legally as the "oyster-gallon cup," which holds 9 pints, wine measure. The shuckers are paid at the rate of 6 cents per "cup," averaging about 65 cents per day, the total wages paid those in Baltimore amounting to about $80,000 annually.

About 800 other persons are engaged in the Baltimore canneries, of whom about three-fifths are men. These employees are paid from $5 to $25 per week, their total

wages amounting to about $90,000 annually. The largest item of expense in the canning houses, aside from the cost of the oysters, is the purchase of tin, labels, etc., this amounting to about $315,000 annually. The incidental expenses of the Baltimore canneries amount to about $25,000. The total cost of handling a bushel of oysters in the canning houses is about 29 cents.

The cost of the oysters for the canning trade at Baltimore has averaged during recent years about 55 cents per bushel. Each bushel yields about 50 ounces of "solid meats." These are packed in 1-pound and 2-pound cans and cans of miscellaneous sizes, most of the latter being a trifle larger than the 1-pound cans, which contain about 5 ounces of solid meats, the 2-pound cans containing 10 ounces each. The price received during the last seven or eight years for the 1 pound and 2-pound cans has averaged about 75 cents and $1.40, respectively, per dozen.

The following summary shows the extent of the oyster canning at Baltimore during the most recent year for which detailed returns are available:

Extent of Baltimore oyster canning in 1891–92.

Capital invested, employees, etc.		Expenses.		Products.		
Establishments, etc.	Number, value, etc.	Items.	Amount.	Cans.	Ounces.	Value.
Number of establishments	20	Cost of oysters	$1,201,600	5-ounce cans, 9,388,650	46,943,250	$764,450
Value of property	$1,255,000	Wages paid shuckers	73,680	10-ounce cans, 4,643,822	46,438,220	725,515
Cash capital	$1,170,000	Wages paid to others	97,500	Miscellaneous cans	22,635,000	366,545
Persons employed	4,848	Tin cans, labels, etc	320,000			
		Incidentals	25,000			
Oysters received, bushels	2,396,763	Total	1,717,780	Total	116,016,470	1,856,510

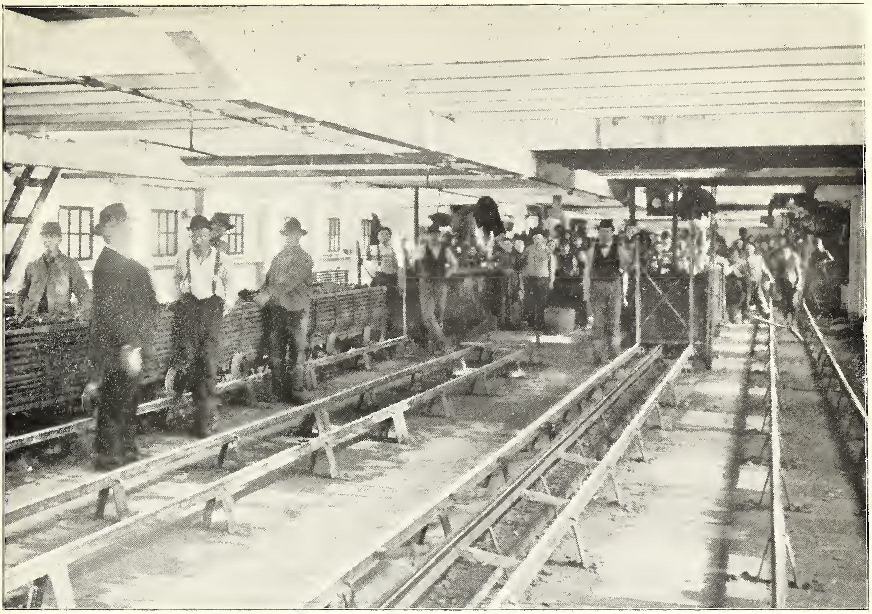
The oysters on the Gulf of Mexico are large and less firm in structure than those of Chesapeake Bay; consequently, when canned in the ordinary manner, they tend to disintegrate and have a somewhat slimy appearance. In 1880 a process was invented by Mr. J. T. Maybury by which the texture of the oysters may be hardened so that they may be boiled without disintegrating.* This process is as follows:

To 10 gallons of pure water add one-half gallon of good commercial vinegar and $1\frac{6}{10}$ gills of a saturated aqueous solution of salicylic acid, to which mixture sufficient common salt is added to impart the requisite salty flavor to the oysters. The mixture is boiled a few minutes and poured over the oysters in the cans, which are at once sealed and placed in a steam bath, the temperature of which is 202° F. This temperature is gradually raised to 240° and maintained at that degree for about 45 minutes. The cans are then vented, resealed, and steamed as before for about 30 minutes, when they are ready to be labeled and packed.

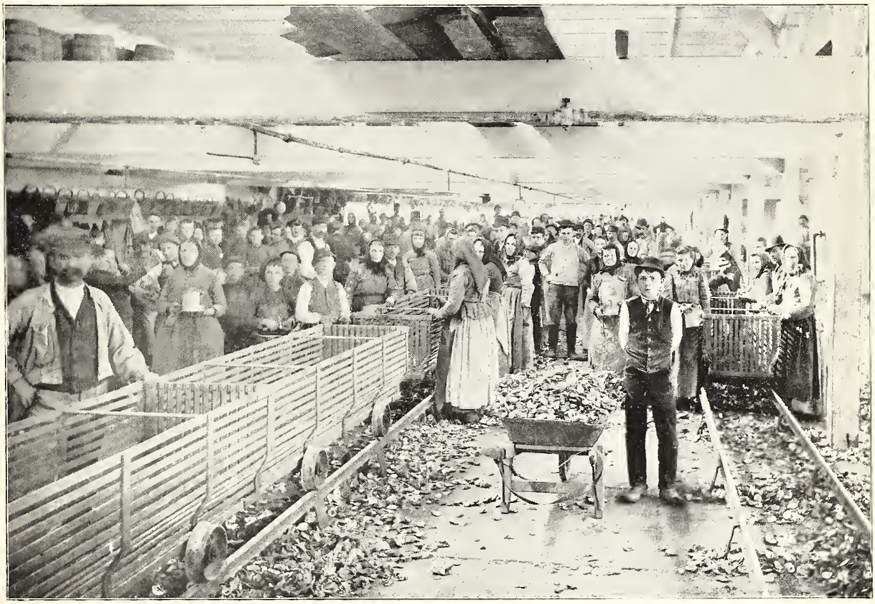
The acids serve to coagulate the fatty portion of the oyster and thereby render its body more dense and firm. The acids are harmless and the quantity is so small that they are not perceptible to the taste.

The term canning is frequently applied incorrectly to a much less permanent method of preserving oysters, viz, placing them in hermetically sealed tin cans or small wooden kegs, which contain from 25 to 200 oysters, without cooking them. By this method the germs within the can or keg and its contents are not destroyed, and the oysters will keep for only a few days, and even then the cans are usually shipped in iced boxes. Twenty years ago a very large part of the oyster trade was carried on

* See Letters Patent No. 230561, dated July 27, 1880.



INTERIOR VIEW OF BALTIMORE OYSTER-CANNING HOUSE, SHOWING ARRANGEMENT OF STEAM BOXES, CARS, TRACKS, ETC.



OYSTER-SHUCKING ROOM, BALTIMORE, MARYLAND.

in this way, but the extra cost of packages and the increased facilities for handling opened oysters in larger packages have almost entirely done away with the shipment in cans. It is yet practiced along the Gulf of Mexico, especially on the Texas coast, and at a few points along the Atlantic coast and in the interior of the United States.

CANNING SOFT CLAMS.

The soft clams (*Mya arenaria*) of the New England coast have been canned in quantities of greater or less extent for thirty years or more, principally by establishments in Maine as a minor part of their output. There are also a few canneries of which the principal output consists of clams. The first clam cannery in this country was established at Pine Point, Me., 8 miles west of Portland, by Messrs. Burnham & Morrill.

The process of canning in general use is as follows: First the siphon or "snout" is cut off, the thin skin or film covering removed, and the clams cleaned in the same manner as when prepared for the table. They are then placed in tin cans, holding from 6½ to 12 ounces, after which the cans are nearly filled with the liquid, diluted with either fresh, salt, or sea water, and the covers soldered on. The cans are next placed in crates and the contents are cooked in a tank of boiling water, the time of boiling depending on the freshness of the clams, usually continuing about 2 hours when the clams are fresh, and a trifle longer if they have been out of water several days. The cans are at once vented and again sealed and boiled about 1½ hours, when they are ready for labeling and boxing.

In some establishments a lining of white paper is placed on the bottom, around the sides, and at the top of the can, to prevent the contact of the contents with the tin, which sometimes results in the clams turning dark.

The product of canned clams in the United States at present amounts to about 40,000 cases annually, valued at $2.50 to $3.50 per case.

CANNING MACKEREL.

There are three distinctive varieties of canned mackerel prepared in this country, differing entirely in the methods of preparation and alike only in that they are sealed in tin cans: (1) fresh mackerel cooked in the manner usually applied to salmon—the oldest and most extensively used process; (2) broiled mackerel; (3) brine-salted mackerel, which are placed in tin cans simply for convenience in marketing.

MACKEREL PLAIN-CANNED.

The preparation of the first variety of canned mackerel was begun in this country in 1843 by Messrs. Treat, Noble & Holliday, of Eastport, Me., and was carried on by them incidentally with the canning of lobsters. During several years following 1843 the output was very small, averaging about 5,000 1-pound cans per year, the public being somewhat slow to fully appreciate the qualities of the product, but from that date to the present time the business has been continued on the Maine and Massachusetts coasts in connection with lobster and other canneries, and the extent of the product has fluctuated from year to year according to the abundance of mackerel on the coast.

In canning fresh mackerel it is quite essential that the fish be prepared as soon as practicable after being removed from the water. In dressing them the heads, tails,

fins, scales, and viscera are removed, the fish cleansed, and soaked for a short time in strong brine to acquire a salty or "corned" flavor. They are next placed and sealed in tin cans which are at once immersed in boiling water until their contents are thoroughly cooked. The cans are then "vented," resealed, cooled, and prepared for the market. The cans are usually $4\frac{1}{2}$ inches in height and 3 inches in diameter, and hold about 1 pound of fish; 2-pound and 3-pound cans are also used to some extent.

The price runs from $1 to $1.30 per dozen 1-pound cans, and the product from 5,000 to 3,000,000 cans annually. In 1879 the output in New England was about 900,000 1-pound cans; in 1880, 1,342,668 pounds, worth $150,449, and in 1881, 2,864,000 pounds.

The decreasing abundance of mackerel has resulted in considerable falling off in the output since 1885. The product in 1892 was about 1,000 cases, and in 1898 very few were put up, probably not over 200 cases, prepared at Provincetown and Boston.

BROILED MACKEREL.

Canning "broiled" mackerel was begun in the spring of 1880 by Eastport sardine canners. Two methods are practiced. The first, which originated with Mr. Julius Wolff, of the Eagle Preserved Fish Company, is almost identical with that used for sardines. The fish are dressed, washed, assorted according to size, dried, fried in oil, and sealed in tins with vinegar and spices.

The second method, which is in more general use, originated with Mr. Henry Sellman, of the American Sardine Company. The small mackerel are split down the belly, the heads and tails being removed, and then cleansed and put in strong brine for half an hour or so. When sufficient salt has been absorbed they are rinsed, spread on wire trays, and placed in a steam box, where they are steamed for a few minutes. The fish, yet on the trays, are baked in the rotary oven described on page 527, and are then packed with mustard, tomato sauce, or spiced vinegar, in oval-shaped tin boxes holding from 1 to 3 pounds each. The cans are sealed and subjected to a hot-water bath, after which they are vented, cooled, and labeled. These mackerel are far superior to any of the brands of herring, and the demand has always been greater than the supply. From 10,000 to 15,000 cases were prepared in 1898, about equally divided into mustards, tomatoes, and spiced vinegars. They are sometimes placed in fancy glass receptacles and are sold at high prices.

CANNING SALT MACKEREL.

The demand for small packages of salt mackerel led, about 1875, to the preparation of them in tin cans. In 1879 the equivalent of about 280,000 5-pound cans was prepared in Gloucester and Boston, about equally divided between the two places. In other parts of the country about 80,000 cans were prepared during the same year. These sold wholesale at about $5 per dozen 5-pound cans.

In preparing this article, the commercial, brine-salted mackerel, usually of the better grades, are used, No. 2 being the most popular size. These are washed and scraped, to give them a neat appearance, and the heads and tails are cut off, and if large the fish are sometimes cut transversely in two pieces. In packing, a small quantity of fine salt is sprinkled in the bottom of the can and the fish are carefully arranged flesh side up, except the top layer, which is placed flesh side down. A small quantity

of salt is then sprinkled over the fish and the top is soldered on. A puncture about one-third inch in diameter is then made at the side of the can, through which the can is completely filled with salt brine. A tin button is soldered over this puncture and the can is cleaned and labeled for market. A barrel of mackerel will "mess" about 180 pounds, which will fill 3 cases each containing 1 dozen 5-pound cans. This work is usually done at the salting-houses, the necessary cans being purchased of the can-makers, and a solderer is employed by the hour.

In addition to the 5-pound cans, 3-pound, 4-pound, and 10-pound cans have been used. The 5-pound cans are of two shapes, each of which is about 3½ inches deep; the first is round and 9 inches in diameter, the second is oval and 6½ inches wide and 9½ inches long. The scarcity of mackerel during the past few years has resulted in very few being put up in this way. When mackerel were abundant, as 12 or 15 years ago, a single firm used to ship 1,500 to 2,500 cases of canned salt mackerel each week, but probably not more than 1,200 cases were prepared in 1898.

CANNING LOBSTERS.

On the American continent lobsters were first canned in 1842, at Eastport, Me., by Messrs. Treat, Noble & Holliday. As is frequently the case in the establishment of new industries, the capital was limited, the appliances were crude, and the quality of the product could not always be depended upon. In 1843 the firm secured the services of Mr. Charles Mitchell, who had engaged in canning during the preceding year at Halifax, Nova Scotia, and who had ten years' experience in the same business in Scotland. Mr. Mitchell improved the processes according to methods employed in his native country, and no further difficulty was experienced in preparing a desirable grade of goods. Letters patent were applied for, but the matter was not pressed and the claim was not granted. During the few years following the origin of the business the 1-pound cans of lobsters sold at 5 cents each, and 3½ pounds, live weight, were required to make a 1-pound can. No lobsters under 2 pounds in weight were used.

In 1880 there were 23 lobster canneries on the United States coast, and the output amounted to 2,049,806 cans, worth $238,000; in 1889 it was 1,170,561 cans, worth $142,613, and in 1892 it equaled 1,235,160 cans, valued at $195,941. Since that year the output has been very small, the product during 1897 and 1898 on the whole of the United States coast not exceeding 20,000 cans annually. While there appears to be no accurate data as to the output of canned lobsters prior to 1880, yet it is well known to have been of much greater extent than at present.

Prior to 1870 the industry was confined almost exclusively to the United States, but the growing scarcity and the increased price of lobsters on the Maine coast soon resulted in the establishment of numerous canneries in the British Provinces by New England capitalists. The number of these canneries has greatly increased, and they now furnish nearly the whole supply of this product. The quantity of canned lobsters produced in the Dominion of Canada during the year 1892 amounted to 12,524,498 1 pound cans, valued at $1,758,425, and in Newfoundland 1,258,308 cans, valued at $176,083, making, with the 1,235,160 cans produced in the United States, an aggregate of 15,017,966 1-pound cans, worth $2,130,449. From 1870 to 1893, inclusive, the total product of canned lobsters in the Dominion of Canada was 254,106,936 1-pound cans, with a total value approximating $38,116,000.

It is cheaper to can lobsters in the British Provinces than in the United States. In this country lobsters, when obtainable, do not cost much more than in the Provinces, but wages are at least 50 per cent higher here than in Canada, where the men receive about $1 per day and the women and children about 50 cents per day. In addition to this, there is a duty on tin in the United States, while that article is free of duty in the Provinces.

The process of canning lobsters on the coast of Maine and in the British North American Provinces is as follows:

The lobsters are first boiled in a large vat or kettle about 20 minutes, after which they are heaped on large tables, usually with the backs up, care being taken to have the bodies more or less straightened out. The boiling is frequently done in the afternoon, in order that the lobsters may have sufficient time to cool during the night. The next morning certain men, designated as "breakers," break off the claws and tails from the bodies, throwing the latter with the refuse, for the reason that, though the carapax contains some good meat, it is difficult to extract and clean it. The sweetbreads, however, are generally saved. The claws are then split by the "crackers," using a small hatchet or cleaver, which opens them so that the meat can be readily taken out. Formerly the tail was split in a similar manner to the claws, but at present the meat is punched out from the tail by means of a small "thole" pin, or other suitable pointed implement. The meat is next thoroughly washed in water, the tin cans filled and weighed to insure uniformity, and then covered and cleaned, after which they go to the sealers, who solder the covers down. Next comes the bathing, the most difficult part of the process. The cans are immersed in boiling water for about an hour, when they are taken out and "vented," a small hole being punched in the cover to release the air, after which they are sealed again and boiled for 2 hours longer. They are afterwards allowed to cool, tested to insure their being tight, and then scoured, painted, and labeled. If the cans are boiled in a retort, say at a steam pressure of 15 pounds to the square inch, which is equivalent to 250° F., the time of boiling is reduced about one-half.*

The preservation of "shell lobsters" was originated as early as 1840 in Christiania, Norway, by Jacob March. In that year he took out a patent in his native country for putting them up in such a manner as to exhibit the red color of fresh-boiled lobsters. It appears that he dipped them in boiling salt water until they reached this color, and then made an incision in the soft part under the tail, thus releasing the water within them, and then placed them in hermetically sealed vessels. The process was never employed extensively and was abandoned within a few years.

The canning of shell lobsters in this country was begun in 1879, at Southwest Harbor, Me. This product is the outgrowth of a demand in the British market for whole lobsters for garnishing purposes. Finding difficulty in obtaining lobsters, as commonly prepared for the trade, sufficiently fresh for this purpose, the London agent for one of the leading packing establishments in Maine suggested the idea of meeting this demand, and satisfactory results were obtained after many experiments. The lobsters, 12 and 14 inches in length and of good condition, are selected from the general stock and boiled, the tail bent under the body, and without being removed from the shell are packed in long cylindrical cans suitable for this purpose. The method of boiling is similar to that ordinarily used in canning lobsters, the only difference being

*See The Fishery Industries of the United States, sec. V, vol. 2.

that they are boiled a little longer in order that the heat may thoroughly penetrate the shell and preserve the meat.

"Deviled lobsters" in half-pound cans have been prepared at several canneries, the article originating in 1871.*

Twenty years ago London was the principal distributing market of the world for canned lobsters, England, France, and Germany receiving about three-fourths of the entire product of the world, which at that time amounted to about 400,000 cases of 48 1-pound cans. The consumption in the United States, then comparatively small, has steadily increased; so that while the total pack has decreased to about 250,000 cases a year, the United States consumes about 100,000, or 40 per cent.

CANNING SHRIMP.

The shrimp-canning industry was established in this country in 1875 by Messrs. G. W. Dunbar & Sons, at New Orleans, La. Their factory was occupied mainly with the canning of various fruits, and utilized shrimp only during the months in which they are most abundant. As the product became better known the extent of the business increased and canned shrimp is now, next to oysters, the most valuable of the marine products canned on the Gulf of Mexico.

The quality of the product during the first year of the business was unsatisfactory, as the direct contact of the shrimp with the tin caused, during the process of cooking and thereafter, a precipitation of black or dark matter which discolored the shrimp and detracted from their flavor and richness, and the liquid in the shrimp constituted a medium for diffusing the coloring matter throughout the can, so that all portions of the contents were equally affected and discolored. This precipitation or coloring is believed to be caused by the action of sulphur contained in the shrimp on the metal of the can. After much experimenting, Messrs. Dunbar overcame the trouble by interposing a lining between the meat and the can, which protected the tin from the action of any acids contained in the shrimp. They also place the shrimp in the lined can while they are in a dry or moist condition and devoid of free liquid, and seal the can without adding any liquid to its contents. The lining consists of any textile fabric in the form of a cylindrical bag or sack, the diameter of which, when filled, permits it to fit snugly within the can. The use of this lining was protected by Letters Patent 178916, dated June 20, 1876, and Reissue 9957, dated December 6, 1881.

The process of canning shrimp at that time, according to the specifications accompanying the letters patent, was as follows:

> The shells having been removed from the shrimp in the usual manner, the fish is thrown into salt water of about 6°, and there remains for an hour, more or less, and from thence to kettles filled with water and brought to a boiling heat, after which they are placed on drippers and cooled and thoroughly rinsed with fresh cold water, from which, so soon as thoroughly dripped and in a moist condition and without the addition of salted or otherwise prepared liquid, they are placed in the sack, the same having been previously arranged in the can. So soon as the sack is filled, the mouth thereof being properly secured, the lid or head is placed in position on the can and immediately sealed. The cans are then subjected to a steam bath or placed in kettles containing boiling water and boiled for two hours at the highest temperature attainable, and which completes the process.

The present method differs somewhat from the foregoing in a few minor particulars. As soon as practicable after being landed from the luggers, the shrimp are

* The Fishery Industries of the United States, sec. v, vol. 2.

boiled in salt water for 30 minutes, and separated from the shells by girls, who use only their fingers for this purpose. The shrimp are then dumped on a small platform, and the shell particles, tentacles, etc., are picked off, after which they are passed through a blower on an endless platform, where the remaining dust and other foreign matters are removed. They are next placed in 1-pound cans containing 10 ounces each, the lining having been inserted. When the cans are filled, the lining covers are adjusted and the lids sealed on and the cans placed in a bath of boiling water for 2 hours. On removal from this bath they are ready for labeling.

Messrs. G. W. Dunbar's Sons (successors to G. W. Dunbar & Sons) now have the only shrimp cannery in Louisiana, though for a few years prior to 1891 a factory owned by Messrs. A. Booth & Co., of Chicago, was operated at Morgan City. At Biloxi, Miss., are three canneries which devote considerable attention to preparing shrimp, the first of these having been established about 1880.

In 1897 the output of canned shrimp in Louisiana and Mississippi was 1,395,168 1, 1½, and 2 pound cans, which sold for $156,190.

In 1879 a shrimp cannery was established at Galveston, Tex., by Messrs. Pecor Brothers. To prevent discoloration of the shrimp, instead of placing a lining of some textile fabric between the fish and the can, as in the Dunbar process, this firm lined the can with a coating of asphaltum cement, which was permitted to dry thoroughly. Strips of paper were then cut, and, after being coated with a hot solution of paraffin, were placed within the can so as to fully cover its interior surface.* The can was filled with shrimp, and the subsequent treatment was substantially as hereinbefore described. In 1880 this cannery was reported as having put up 75,000 1 pound cans of shrimp, worth $13,000, but a large decrease in abundance of shrimp in Galveston Bay necessitated its closing down a few years later.

Another method of lining the inside of tin cans to prevent the direct contact of the shrimp with the metal was devised by Louis Lenglet, of St. Louis, Mo. This consists in providing a lining of corn husks, covering the inside annular body of the can as well as the top and bottom. It is claimed that corn husks have the advantage of requiring no previous treatment with acids to neutralize or destroy any peculiar odor or flavor of the material, and that such lining keeps its shape well, is sufficiently thin and flexible, and not expensive.

Shrimp are also canned in Japan by a process similar to that employed in this country. Specimens of the Japanese product were exhibited at the World's Fair, Chicago, 1893.

CANNING CRABS.

The canning of crabs originated in this country about 1878, with Mr. James McMenamin, then located at Norfolk, Va. He first attempted to follow the methods used in canning lobsters, but not meeting with satisfactory results he started out on original lines, the product being first placed on the market in the fall of 1878. On account of the greater abundance of crabs in that vicinity, Mr. McMenamin moved to Hampton, Va., in April of 1879, and began operations on a large scale. In that year another cannery was established at Hampton by Mr. T. T. Bryce. In 1879 these two canneries used 6,000,000 crabs, producing 84,000 2-pound cans, worth $16,800. One

* Letters Patent No. 226347, dated April 6, 1880.

or two other canneries have been established since, the principal one being at Biloxi, Miss. The present annual output in the United States is valued at about $45,000.

The season for crab canning in the Chesapeake begins in April and continues until October, except that sometimes the work is discontinued during June and July on account of the large number of crabs with spawn, in which condition they are not suitable for canning.

The crabs are placed in open slat-work cars, usually of a size sufficient for holding about 250 dozen, and are rolled into a steam box, where they are cooked 20 or 30 minutes, when they become red. The cars are then rolled out of the steam chest and the crabs passed to the "strippers," who remove the outer shells, viscera, and small claws. The crabs next pass to the "pickers," consisting principally of women and children, who remove the meat from the bodies and the claws, crushing the latter with the handle of the knife employed in the work. Different operatives are employed for picking the bodies and the claws. The pickers generally receive from 2 to 3 cents per pound for this work, and the most skilled among them prepare 40 or 50 pounds per day, but the average quantity is about one-half of this.

After being weighed the meat is placed into cans of two sizes, 1 pound and 2 pounds, about 12 crabs being required to each 1-pound can. The cans are sealed, boiled for half an hour, and then vented. They are at once resealed and boiled for a second time (making the third time that the meat has been cooked) for about 2 hours. The length of the second boiling may be shortened by increasing the possible temperature of the water, which is usually done by adding chloride of calcium thereto.

When the cans have been properly cleaned and labeled, they are packed in cases holding 48 1-pound or 24 2-pound cans, and sold wholesale at about $8 and $6 per case, respectively. A package of shells usually goes with each case of cans, four shells being allowed for each 1-pound can.*

It is stated that in 1891, 3,838 barrels of crabs, worth $6,141, were canned in Virginia, yielding 1,095 cases of 1-pound cans and 2,880 cases of 2-pound cans, worth $7,884 and $16,128, respectively. In 1890, 6,363 barrels, or 2,386,256 crabs, worth $5,090, were used, producing 1,277 cases of 1-pound cans and 5,472 2-pound cans, worth $9,194 and $30,643, respectively. In 1897 the output was 1,992 cases of 1-pound cans and 3,898 cases of 2-pound cans, worth $14,177 and $22,064, respectively.

When intended for nearby markets, and for consumption within 4 or 5 days, the crabs are not usually canned, but the meat, after being removed from the shell, as in case of canning, is placed in 10-gallon tins, a piece of ice placed in each tin to keep the flesh cool, and the tins placed in refrigerators. When orders are received, the ice is removed and the meat repacked in tin or wooden buckets of suitable size, containing ½ gallon, 5 gallons, 8 gallons, and 10 gallons, and the buckets placed in a small barrel in much the same way that ice cream is packed for shipment, ice being placed all about the can or bucket. Sometimes a small lump of ice is placed in the bucket, and some dealers also use an antiseptic, such as boracic acid. The crab meat is sold at $1 to $1.50 per gallon, wholesale, and with each 10-gallon bucket half a bushel of empty shells are sent without extra charge. This trade is carried on at Annapolis, Crisfield, Hampton, Norfolk, and other ports on the Chesapeake Bay.

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*Fishery Industries of the United States, sec. v, vol. 2, pp. 646–647.

SARDINES.

The most valuable of the marine products canned in oil is the preparation of small fishes of the herring family, in the form known generally as sardines. This industry was established at Nantes, France, about the year 1834, and it was introduced in the United States about 1875. It has reached its greatest development in Brittany, the most costly brands on the market being canned on that coast. Sardines are now prepared in France, Spain, Portugal, Italy, Norway, United States, Brazil, Mexico, etc., but the industry has three principal geographical centers: (1) the Mediterranean coasts, (2) the Bay of Biscay and the Atlantic coasts of Spain, and (3) the coast of Maine. In each one of these regions methods are employed quite at variance with those used in the others.

The preparation of sardines began in the United States about 1875 and has gradually increased in extent, though it was confined within comparatively narrow limits until 1880, when 13 new canneries were established, there being only 5 operated previously. In 1886 there were 45 canneries, and since that year the value of the output has averaged about $2,000,000 annually, all prepared on the coast of Maine, and nearly all in the counties of Washington and Hancock. On the Maine coast 37 factories were engaged in canning sardines in 1889, 46 in 1892, and 60 in 1898. A few sardines are prepared also on the Pacific coast of the United States.

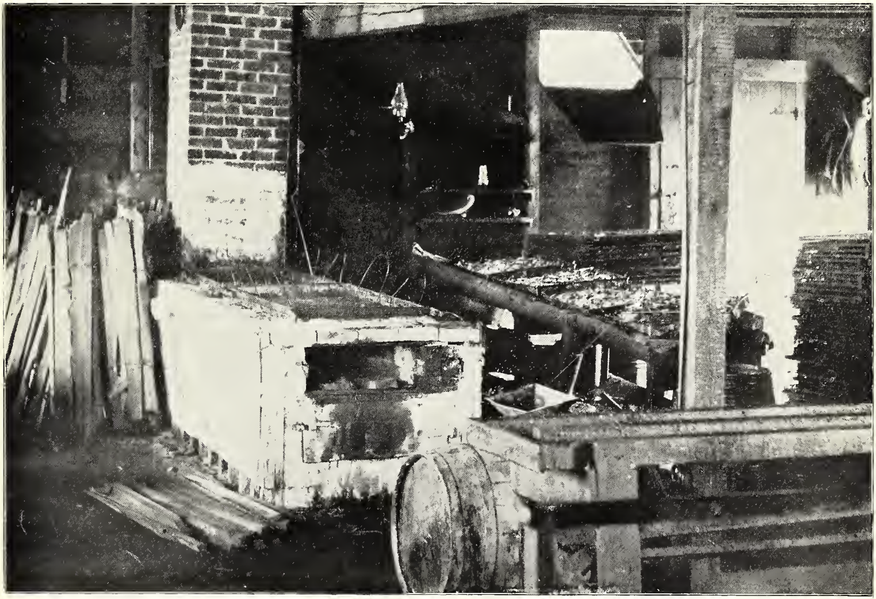
SARDINE CANNING IN MAINE.

The herring used in the sardine industry in Maine are from 5 to 10 inches in length, and are taken from the middle of April to the middle of December, by means of weirs, and to some extent in gill nets and seines. The present method of preparing these fish as sardines is as follows:

On reaching the factory the fish are at once distributed along the middle of the cutting tables where they are quickly decapitated and eviscerated. It was formerly customary to remove the tails, but this is no longer practiced. As each fish is dressed it is thrown into a cutting box placed under the edge of the table. They are next washed by being dipped with a scoop net into a washing tank, through which water is constantly running, and are immediately immersed in strong brine from 15 minutes to 1 hour, the length of time depending upon the size and fatness of the fish, their freshness, and the condition of the weather. In cold weather, owing to their firmness, they must be salted longer than in the summer. As soon as they are sufficiently "struck" the herring are removed from the brine and allowed to drain in baskets. They are afterwards carried to the flaking room and arranged upon flakes, which are wooden frames about 3 feet long and 22 inches wide, filled in with wood or galvanized wire stretched across and separated by 1 or 2 inches, so as to give a free circulation of air and to touch the fish at only a few points, in order that evaporation may go on from all parts of the body. Each flake holds about 110 fish, placed in rows with the tails in the same direction, so that when fixed in the drying room, with the anterior part lowest, the moisture will more readily drip from them.

Next comes the drying process, which is of much importance, and great care must be observed that no decomposition occurs before it is completed. Originally the fish were dried in the open air by action of the sun, as is the present practice in France,

DRESSING HERRING FOR SARDINES IN MAINE.



FRYING SARDINES AT EASTPORT, MAINE.

but owing to the moist atmospheric conditions about Eastport, even those factories that make use of this method whenever possible are obliged to supplement it by artificial means. The factories are, one after another, discarding entirely the sun-drying process, occasionally using a drying room, but more frequently adopting a patented drying apparatus similar to a baker's rotary oven. Drying rooms are usually located on the top floor of the cannery, with movable racks for holding the flakes obliquely, each rack containing 40 or 50 flakes, placed about 3 inches apart and directly over each other. The room is supplied with a constant current of warm, dry air, brought from stoves or furnaces in the lower part of the building by means of large pipes, and which finally escapes through ventilators in the roof.

The oven that has been quite generally adopted in the sardine canneries was introduced by Henry Sellman in 1880,* and is similar to an ordinary rotary oven of large size, and serves not only to dry but at the same time to cook the fish. It is about 15 feet square and 18 feet high, and contains 6 or 8 skeleton iron frames attached to arms extending from a cylinder and which remain in a horizontal position while revolving in the oven, like the cars of a Ferris wheel. In these ovens the fish are subjected to a temperature of about 250° F. for 10 to 25 minutes, according to the size of the fish, but the time required for drying varies. In open air or in a drying-room it may take the greater part of a day; in a furnace-heated drying apparatus from 2 to 7 hours, and in an oven only a few minutes, as before stated. The use of ovens is becoming more popular, and most of the canneries are now fitted with them.

When fish are oven-dried they need no further cooking, but are at once cooled and packed in cans. In other cases they are placed in shallow wire baskets or other proper receptacles and immersed in oil of suitable quality and heated to a temperature of about 220° F. This is for the purpose of frying and expelling from the fish all moisture remaining in them after the drying process. Cotton-seed oil is used mostly, and it is placed in a pan to the depth of about 2 inches and the fish immersed in it from 1 to 3 minutes. This oil can be used only a short time, since water and gluten from the fish pass into it and injure its flavor. For this reason the pan must be cleaned frequently and the oil renewed. The oil is boiled either by direct furnace heat or by the passing of steam through coils of pipe in the frying tank. The latter was introduced in 1884 and has many advantages over the old method of direct furnace heat. About half of the factories which fry their fish do so by means of steam, and, as is the case with other improved methods, the number is increasing.

Mr. R. E. Earll states on page 178 of U. S. Fish Commission Bulletin for 1887:

> It is said that the fish which have been fried have a better flavor, and, having absorbed more oil, keep longer than those baked in an oven. It is claimed, however, by those using ovens, that by the baking process very much depends upon the skill of the baker, and that at its best it may produce results equal if not superior to those of the old system. It appears that the first fish fried in a given quantity of oil are better than the best baked fish, but that, as it is necessary, in order to keep the expenses within reasonable limits, to use the same oil for frying successively a great many pans of fish, the fluid soon becomes filled with scales and small particles of fish, which burn on the bottom and impart to the product a bitter and unpleasant taste. In baking, on the other hand, when it is properly done, the fish are all of a quality equally good.

Instead of the ordinary methods of cooking, some factories employ an endless belt, 200 feet long, which runs in a wooden case 100 feet long. At one end of this case is a revolving fan which forces a blast of hot air over the fish that have been spread on

* Letters Patent No. 223682, dated January 20, 1880.

the belt at the other end of the case. After passing along the belt once the fish go into the bath of boiling oil and are treated in the usual manner. With this apparatus the several flakers required by the old method are represented by one woman, who spreads the fish on the belt, and a man who turns a crank which moves the machinery.*

After leaving the frying-pan or the oven and draining and cooling, the fish are assorted according to size, and those of like size are placed in tin cans or boxes previously filled with oil, or, in some cases, mustard sauce or vinegar with spices. Up to within a few years, although other oils were used in the frying, the sardines were packed in olive oil, either alone or mixed with inferior kinds, but at present its use has been almost entirely superseded by cotton-seed and nut oils. This change is accounted for by the facts that the heavy duties make olive oil very expensive, that it will not keep as well as cotton-seed oil, and that the latter can be made exceedingly palatable. It is claimed by some canners that even at the same price cotton-seed oil is more desirable for the Maine sardines, because the fish imparts its distinctive herring flavor to olive oil much more readily than to cotton seed, the latter covering it up somewhat. It is stated that at some of the canneries even tallow oil and herring oil have been used. Peanut oil, which is sometimes used, is said to be even better than cotton-seed oil. The oil is usually flavored to the taste by adding lemon, sugar, and various spices. The olive oil used in France for sardines is said to be often largely adulterated with American cotton-seed oil, as well as with palm and other oils.

In packing the fish, those of the most desirable size are packed with a dozen in each can; the number is never smaller than seven or eight. The smaller fish are generally packed in oil in "quarter-cans," which are 4½ inches long, 3 inches wide, 1 inch deep, and contain from 9 to 12 herring measuring from 3½ to 4 inches when dressed. The larger fish, measuring from 8 to 9½ inches in length when whole, or from 4 to 4½ inches dressed, are occasionally placed in oil, but more frequently are put in mustard, spices and vinegar, tomato sauce, or other condiments, in "half-cans," holding from 10 to 16 fish. These cans are 4½ inches long, 3½ wide, and 2 inches deep. Occasionally "three-quarter" cans of oil sardines, or in tomato sauce, and "half" or "three-quarter" cans in spices are put up, and in rare instances small fish are put up in mustard or spices in quarter-cans.

When the cans have been filled with fish the covers are sealed on, and the filled cans are then ready for bathing, and are placed in boiling water, where they are allowed to remain from 1½ to 2 hours, according to the size of the cans. Fish prepared with spices must be boiled longer than those prepared entirely with oil. The time of boiling may be considerably reduced by introducing a proper quantity of chloride of lime or other chemicals into the water, by which the temperature may be raised to upward of 250° in the open air. Some canneries accomplish this by using a closed bath. By either of these methods the time can be reduced to about 30 minutes.

Formerly, after the bath, the cans were punctured, to allow the inclosed air to escape, and the puncture was thereupon closed with solder. In this process, when the cans are punctured the escaping air carries a portion of the oil with it, so that when the cans are opened the fish are found to be only partly covered with oil, and consequently not in a state of perfect preservation. If the can has been properly sealed, the top and bottom become level or horizontal when boiled the second time. The fact that it does not expand into a level position is sufficient evidence that there is a defect

* Bull. U. S. Fish Commission for 1890, p. 117.

in the soldering, and it is at once resoldered, punctured in two or more places, and placed in hot oil until it is again filled with oil, when the punctures are soldered.

In 1884 it was discovered* that the process of venting could be avoided by making the can with concave top and bottom. The depression of the middle part causes the air in the cans to collect about the edges of the top, and the heat of the soldering tool heats the air and causes it to expand and escape in front of it as it passes along the edge, so that when the soldering is completed the air will be sufficiently expelled. Venting is no longer practiced in preparing the ordinary quarter size, but it is generally adhered to in the treatment of the half and three-quarter cans.† Some of the factories partly immerse the half and three-quarter cans in boiling oil, driving out the air and rendering venting unnecessary.

In the specifications forming a part of the Letters Patent No. 223682, dated January 20, 1880, issued to the inventor of the rotary oven for baking, the following account is given of the methods of preparing sardines on the Maine coast, and the improvements effected by using that oven:

> After the fish are landed they are subjected to the process of decapitation and disentrailment and salting for a suitable period. They are then washed clean and placed in shallow baskets to drain, after which they are separately spread on lath or other suitable frames for drying to a certain extent. After the fish have been sufficiently dried by exposure to the atmosphere or to an artificial current of warm, dry air they are placed in shallow wire baskets, or any other suitable receptacle, and immersed in oil, suitable in quality and heated to a certain degree, for the purpose of frying and expelling from the fish any parts of water which remain in them after the drying process. They are then allowed to drain, and are packed in tin cans. This mode of drying by natural or artificial currents of air and frying the fish in oil is, for reasons hereinafter stated, very deleterious to the quality of the article of fish to be put up, and the invention herein set forth tends to do away with and overcome the former objectionable method. The fish used for the purpose indicated are of a very tender and delicate nature. They do not admit of much handling, and, owing to this delicacy of nature, are subject to very rapid decomposition, as they should be salted but very slightly.
>
> The process of drying the fish, either in open air or by an artificial current of warm dry air, takes so much time, that decomposition of the fish to a greater or less extent is unavoidable, as 3 to 24 hours are consumed in drying the fish sufficiently by the modes indicated.
>
> In frying the fish in oil, as now practiced, the quality of the oil in which quantities of fish are fried is rapidly deteriorated by the water from the fish, which is not evaporated, and from the gluten from the fish passing into it. A large percentage of the fish is also lost by breaking during the process of frying in oil. In our improved process the fish, after landing, are decapitated, disentrailed, salted, and washed. They are then spread on wire netting or other frames made of suitable metal and of any suitable size. They are then subjected to a process of steaming by live steam, which is injected from a steam-boiler into an upright chamber of suitable size, lined with sheet metal, and provided with narrow internal flanges or shelves, upon which rest the wire frames which hold the fish. The steam passes through the closed box and escapes through an opening in the side or end opposite to where it is introduced. A door opening outward is also provided for obvious reasons.
>
> The time consumed in this process is from 10 to 20 minutes, according to the power of the steam employed, and may be performed within 2 hours after the fish are first landed. This steaming process has the effect of evaporating the water from the fish in a much more thorough manner than by the old process. It has also the effect to prepare the fish for the subsequent baking process, and by killing any germs in them preventing rapid decomposition, keeping them sweet, and retaining their natural flavor. After the steaming process the fish (which remain on the same frames on which they were steamed) are subjected to the baking heat of a revolving reel oven, operated by steam or any other power, until they are fully cooked or baked. They are then taken from the revolving reel oven, cooled a certain time, and packed in tin cans, which are supplied with fine oil, mustard, sauces, spices,

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*See Letters Patent No. 299710, dated June 3, 1884.

†See the Fishery Industries of the United States, section V, vol. 1, pp. 511-518, and Bulletin U. S. Fish Commission, 1886, pp. 177-179.

or vinegar, as desired. The cans are then soldered and subjected to the action of a bath of boiling water for a certain period, for the purpose of expelling all air from the cans by the usual process.

The essence of the whole mode of procedure consists in preserving the fish against decomposition by steaming and baking, as set forth, thus preventing breaking of the skin, curling and breaking of the body, and thus evaporating from the fish all water, and then, while in this baked condition, subjecting them to the preservative process of canning similar to that practiced with sardines, inclosing in tin cans with oil, mustard, spices, etc.

An appliance recently devised for testing the cans before they are filled is thus described by Mr. Ansley Hall:

It consists of a cylindrical tank about 5 feet in length and 1 foot in diameter, fixed in an upright position at the end of a table. The tank is filled with water to within about 18 inches of the top by means of a pipe leading from the boiler of the engine. Air is forced through another pipe into the space above the water by the air pump which supplies air for oxygenizing the flame of the kerosene-oil stoves used in soldering. The pressure of air, which requires to be about 12 pounds, and the quantity of water are regulated by steam and water gauges. On the table, a few feet from the tank, is a tin pan or tray, in the center of which is a rubber pad, a little larger than a sardine can. A pipe fitted with a valve leads from the tank and passes up through the pad from the under side of the table. The can when tested is placed bottom upward over the nozzle of the pipe and held in position by pressure applied with a lever worked by the foot. The operator then turns a thumb piece on the pipe, which opens the valve and lets a small stream of water into the inverted can. If it is not perfectly tight, the leak is immediately disclosed by the fine jet of water which passes through it. The water, after being used, escapes by a waste pipe in the tray. One advantage of this method is that it shows which class of solderers has done the poor work, whether the seamers or can-makers, and the defective cans are returned to them for the leaks to be mended, after which they are again tested in a similar manner. If any cans are imperfect after coming from the bath, the fault is known to lie with the sealers. An improvement is contemplated by arranging the valve to open with the lever when the pressure is applied, and thus avoid the movement of the hand in turning the thumb piece. The apparatus costs about $15, and is operated by one person.

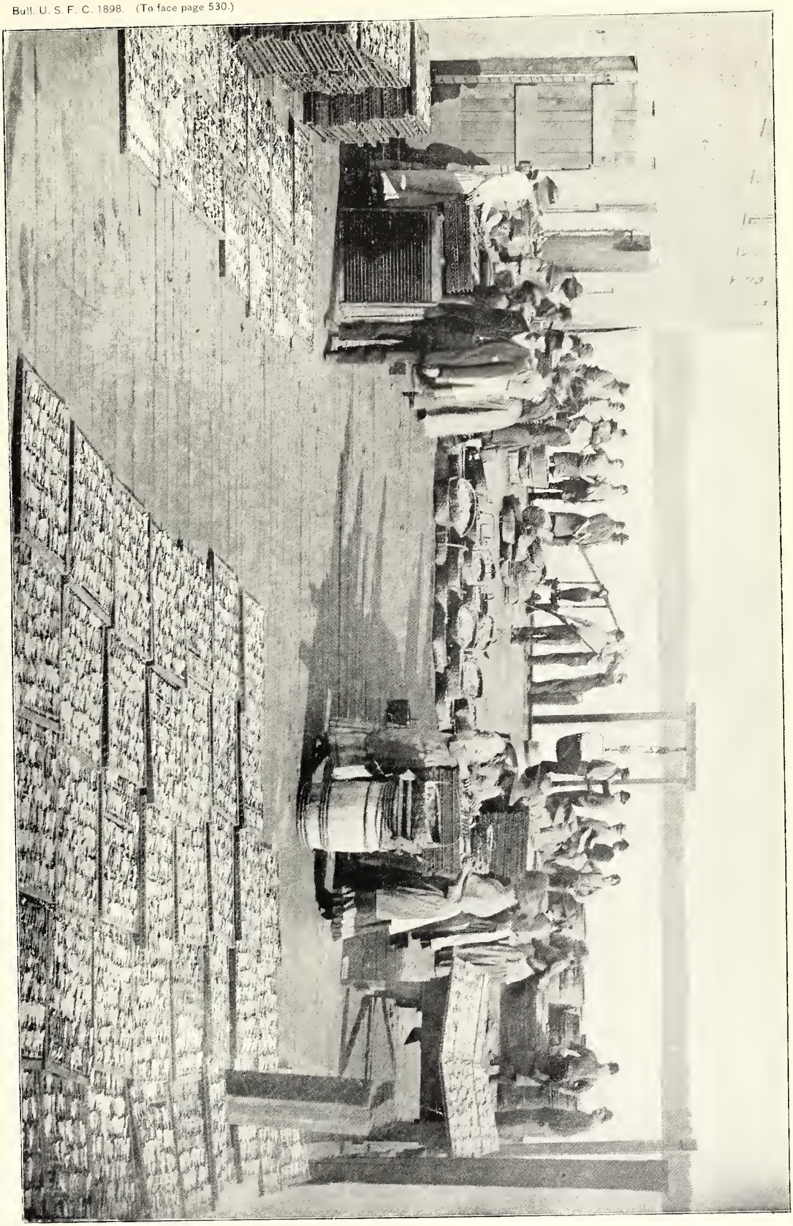
On the Maine coast many sardines are put up in mustard and in spices, usually with a quantity of the best quality of vinegar. While these are considered equal to the sardines in oil, they are usually sold at a lower price. In 1892, 154,051 cases of sardines in mustard were prepared, the value of which was $457,445; and 10,020 cases of sardines in spices, worth $32,425, were prepared.

Nearly every year a small quantity of sardines are put up in tomato sauce, but these do not keep very well and the demand for them is small. In 1889 the Maine canneries prepared 279 cases of them, worth $762.

The following shows in detail the sardine output of Maine in 1889 and 1892:

Description.	1889.		1892.	
	Cases.	Value.	Cases.	Value.
Sardines in oil:				
Quarters	261,940	$1,013,877	396,428	$1,455,245
Halves	9,881	56,716	6,614	31,870
Three-quarters	1,025	4,100		
Sardines in mustard:				
Quarters	4,127	20,635	5,031	21,582
Three-quarters	158,069	553,242	149,020	435,863
Sardines in spices:				
Quarters	1,062	5,310	543	2,145
Three-quarters	5,609	21,034	5,705	18,011
One pound	74	277		
Two pound	10	26	730	1,643
Three pound			1,042	3,126
Odd sizes	36	126	2,000	7,500
Sardines in tomato sauce:				
One pound	256	704		
Two pound	23	58		
Total		1,676,105		1,976,985

PLATE XL.



LANDING, CLEANING, WASHING, AND FLAKING FISH AT SARDINE CANNERY, EASTPORT, MAINE.

From Mr. Hall's excellent report on the "Herring Industry of the Passamaquoddy Region" is extracted the following tabular statement, showing the cost per case of quarter-oil sardines in 1895, the statement being prepared on a basis of seven cases for convenience in manipulating some of the items.

Statement of the cost per case of quarter-oil sardines in 1895.

Material:	
Tin plate for 7 cases, at $3.40 per box	$3.43
Decorating 35 sheets of tin plate	.58
Oil for 7 cases, at 30 cents per gallon	2.10
Solder for 7 cases, at 25 cents per case	1.75
Fuel for soldering, soldering coppers, and acid	.21
Shooks and nails for 7 cases	.53
Fish, at $3.14 per hogshead	1.10
Coal, wood, sawdust, and salt	.12
Waste of material, 1 per cent	.10
Material for 7 cases	9.92
Material for 1 case	1.42
Labor:	
Cutting, rimming, and bending tin	.20
Cutting two-thirds of 1 box of tin on dies	.14
Seaming cans for 7 cases, at 5 cents per case	.35
Making cans for 7 cases, at 12 cents per case	.84
Sealing cans for 7 cases, at 30 cents per case	2.10
Cutting and flaking fish for 7 cases, at 10 cents per case	.70
Packing 7 cases, at 10 cents per case	.70
Making 7 cases, at 1 cent per case	.07
General labor on 7 cases, at 18 cents per case	1.26
Labor—Continued.	
Trucking 7 cases, at 1 cent per case	.07
Labor for 7 cases	6.43
Labor for 1 case	.92
Expenses of shipping and selling:	
Freight on 7 cases, at 10 cents per case	.70
Commission on 7 cases, at 5 per cent	.87
Discount of 1 per cent for cash payment	.17
Fire and marine insurance	.06
Expenses on 7 cases	1.80
Expenses on 1 case	.25
Total cost of 7 cases	18.15
Total cost of 1 case	2.59
Summary of the cost per case:	
Material	1.42
Labor	.92
Cost at cannery	2.34
Expenses of shipping and selling	.25
Total cost per case	2.59

Mr. Hall further states:

An estimate similar to the above, made in 1886, showed the cost of quarter-oils at that time to be $4 per case at the factory. The material then cost $2.83 and the labor $1.17, whereas the material now costs $1.42 and the labor 92 cents, a total of $2.34 per case. The cost per case was therefore $1.66 or 41½ per cent less in 1895 than in 1886. In the estimate for 1886 the fish were reckoned at $6 per hogshead, but the average for that year was about $9; hence it is probable that the actual difference in the cost of production was even greater than these figures show. It will be noticed that the reduction in cost since 1886 has been more largely in material than in labor, the cost of material in 1895 being nearly 50 per cent less than in 1886, while that of labor was only 21½ per cent less. Of the total difference, 85 per cent is in material and 15 per cent in labor. Prior to 1886 the cost of manufacturing sardines was somewhat greater than it has been at any time since, but it was probably never more than about $7 per case. The price of the products has therefore fallen much more rapidly than the cost of production, and consequently the profits have been constantly diminishing. It was not until after 1880 that the cheapening of the cost of the products became an imperative necessity.

In the strong competition between the various manufacturers the quality of the goods has in a measure been sacrificed to the interest of producing large quantities. When the industry was first established, it was the ambition of the packers to make the quality of the domestic product equal, if possible, to that of the sardines imported from France and other countries, and thus secure at least a part of the trade which was then wholly supplied by the foreign manufacturers. It was also hoped that when the supply should exceed the demand of the home market the surplus stock might be exported. To this end, therefore, the best quality of material was used, and the greatest care was exercised in the methods of preparation, and for a few years the quality of sardines put up at Eastport, while somewhat inferior to the best, was equal to that of the average brands imported. Had these efforts been continued until the present time, it seems not improbable that a still higher standard of excellence would have been attained. Attention was, however, soon directed toward reducing the cost of the products. One of the most important changes made was that of substituting cotton-seed and nut oils of various kinds for olive oil. This practice began to some extent before 1880, but did not become general until after that date. The cheaper oils were first introduced for frying the fish, but in a short time they were also used for packing them in the cans. Changes have also been made in the methods of preparing sardines in order to render the performance of the work more rapid and thus increase the capacity of the canneries at a reduced ratio of cost.

There appears to be some doubt in the minds of the packers whether or not the herring (*Clupea harengus*) which is used for sardines on the coast of Maine is susceptible of being so prepared that it will be equal in quality to the best imported sardines. It may be quite safely asserted that the character of this species does not offer any insurmountable barrier. The sardine (*Clupanodon pilchardus*) used in France, which is the young of the pilchard, the English sprat (*Clupea sprattus*), and the California sardine (*Clupanodon cæruleus*) all belong to the same family of fishes as the herring, and it is probable that any superiority which one may have over another, when packed in oil, depends more on the quality of the oil and the method of treatment than on the natural characteristics of the species. That the experiment is a hopeful one as to its effect on prices is indicated by the fact that in 1895 considerable quantities of goods were so improved in quality that they were sold for at least 50 cents more per case than the best average brands. This improvement consisted mainly in frying the fish and in the exercise of greater care in their preparation. There is no doubt that their value might have been still further enhanced by the use of either olive oil or olive oil blended with other oils of a delicate flavor.

For further information regarding the preparation of sardines in Maine, and the present condition of that industry reference is made to Mr. Hall's above-mentioned report (The Herring Industry of the Passamaquoddy Region, Maine, by Ansley Hall, United States Fish Commission Report for 1896, pp. 443–487).

SARDINES ON THE PACIFIC COAST.

Within the past few years sardines of choice quality have been prepared at San Pedro, Cal. The following account of the species utilized and of the industry is from a recent report (Bulletin for 1894, pp. 227–230) of the United States Fish Commission:

The California sardine (*Clupea sagax*) is very closely related to the sardine of Europe (*C. pilchardus*), from which it chiefly differs in having no teeth and less strongly serrated scales on the belly. It attains a length of nearly a foot. It is found along the entire Pacific coast of the United States. The fish is, however, most constant in appearance and most abundant on the southern part of the coast, and it is doubtful if it exists in sufficient numbers to maintain a regular fishery north of San Francisco. Even at that place the supply is uncertain. While there have been periods of years in which the sardines were found in San Francisco Bay in large quantities, and for a considerable time in each season, for the past five years they have been very scarce.

The distribution of the anchovy (*Stolephorus ringens*) is similar to that of the sardine. It occurs in abundance along the entire coast, and is often found in enormous quantities in Puget Sound, San Francisco Bay, and elsewhere. It reaches a maximum size of about 7 inches. In most places it is known as the anchovy, but in Puget Sound, according to Swan, it is called "sardine."

The natural advantages which the west coast possesses for the canning of sardines and other similar fish are unusually good, and are superior in some respects to those of the east coast. At least the two fishes named, the sardine and the anchovy, suitable for canning as "sardines," occur in large quantities, the first named very closely resembling and being an excellent substitute for the sardine of southern Europe. The dry atmosphere and other climatic conditions of the southern coast of California are very favorable for the preparation of a good grade of canned fish. The culture of the olive supplies a native oil of superior quality, which is essential in the canning of the best goods. Another item of importance to canners in this connection is the abundance of cheap labor. The chief desideratum in the establishment of a factory for the canning of sardines (and other similar species) is a regular supply of fish during a certain period. This is thought to be of greater importance than an abundance of fish at uncertain or irregular intervals.

While the sardine ranges along the whole western coast of the United States, and is at times very abundant even as far north as Puget Sound, it is doubtful if in Washington or Oregon a supply sufficiently large and regular exists to warrant the machinery, etc. This matter has already received the consideration of some salmon canners; but the general canning of sardines by salmon packers is not anticipated as long as the supply of salmon lasts.

Personal observation and inquiry, the testimony of fishermen and dealers, and the studies of ichthyologists afford ground for the belief that the successful operation of a sardine cannery can not be expected any farther north than San Francisco, and the history of the industry at that place seems to indicate that the northern limit of satisfactory work is even farther south. South of San Francisco,

the prospects of profitable business appear to be in direct relation to the latitude; the more southern the location of the cannery the more constant and abundant the supply of fish.

In 1889, a canning factory was established in San Francisco which continued in operation until August, 1893. During the five years in which the cannery was run the yearly pack was from 5,000 to 15,000 cases. The canned fish consisted chiefly of anchovies in oil in ¼-pound cans and large sardines in 1-pound and 2-pound round cans. The fish consumed at the factory were caught in San Francisco Bay with haul seines. In the earlier years sardines small enough for use in quarter-pound cans were obtained, but during the last two years of the cannery's existence no sardines of size suitable for "quarter oils" could be had. This was the chief reason for closing the works.

In this region sardines are found throughout the year. They "show" at the surface at times, and thus permit the use of the purse seines. They sometimes go in immense schools. Single hauls of several tons are often made, and 10 tons have on several occasions been taken at a single set of the seine, such a catch being obtained about May 1, 1894. In December, 1893, several very large bodies of sardines were observed, and a haul of 10 tons of small-sized fish was taken. From January to June the fish appear to gradually increase in numbers. Some schools are made up of fish of uniform size, while in others they are mixed. The smallest fish caught are 4 inches long, the largest 12 inches, the average 7 inches.

The condition of the fish in regard to fatness varies considerably with the season. Mr. J. H. Lapham, the president of the fish company operating the cannery, states that in December, 1893, when the canning began, the smaller fish were poor, while the larger ones were fat. In January and February conditions were about the same. In March the smaller fish began to improve, continued to grow fatter through April and May, and in June sardines in excellent condition, suitable for "quarter oils," were taken. In May 4 or 5 tons of large fish that were poor were seined on one occasion. The factory is under the superintendence of an experienced fish-canner from Maine. It is a large two-story structure, with a salting-house attached. The plant is worth about $10,000.

The principal processes to which sardines are subjected before emerging as the canned product are as follows: When the fish are unloaded from the vessel they are received into a large, airy room, where the cutting and washing are done, and then transferred to the second floor by means of an elevator. There they are next arranged on latticed trays (32 inches square) and dried. If the weather is fair and the atmosphere dry, the drying is done in the open air, occupying, as a rule, about 2½ hours. On rainy days, or when the air is especially humid, drying is accomplished inside the building by means of steam, which requires about 10 hours.

After drying, the fish are placed in wire baskets (22 inches long, 18 inches wide, 3 inches deep) and immersed in boiling oil for 2 to 6 minutes, depending on their size. The oil is contained in a shallow sink, into which the wire baskets fit and are lowered and raised by means of long wire handles. The boiling of the oil is done by means of a steam pipe entering at the side and running under the sink. After draining and thoroughly cooling, the fish go to the packers, thence to the sealers, thence to the bathmen, and, after cooling and testing for leaks, to the boxing room.

The cutting of the fish is done by men and girls, the average number of whom employed is 25. They are paid by the basket or the bucket of cut fish, and by working steadily earn about 25 cents an hour. The flakers number 12 to 14, and are the same girls who pack the fish in the cans. Ten men act as sealers and can-makers, and 10 others are employed in the remaining branches of the work.

The sizes and grades of canned sardines placed on the market from this cannery, and the wholesale prices received, are as follows: Quarter oils, 100 cans to a case, $6.50 to $8.50 per case, according to the quality of the oil; half oils, 50 cans to a case, $5.60 per case; 2-pound oval cans, with mustard spices, and tomato sauce, $2.25 per dozen cans.

MENHADEN AS SARDINES.

Some years prior to the establishment of the Maine sardine industry the extensive market in the United States for sardines led to numerous attempts to obtain an article that would compete with the foreign product. Among other species the immature menhaden was tried with considerable success. The American Sardine Company prepared this species quite extensively from 1872 until the development of the sardine industry at Eastport. In 1871 the company located a factory near Port Monmouth, N. J., and for nearly a year experimented with various processes with a view to remov-

ing or softening the numerous bones in the menhaden without the use of vinegar or other acids. They adopted a process, described in Letters Patent No. 127115, dated May 21, 1872, which consisted in successive steaming, combined with an intervening cooling, which softened the bones so that they might be eaten without inconvenience.

Their treatment of the fish was as follows: When landed, which must be very soon after they are removed from the water, the fish are cleaned, scaled, and dressed, and slightly salted in hogsheads. After remaining in salt a few hours, depending on the temperature and the size of the fish, they are placed in cooking cans, which are a little larger than the market cans, and put in a steam chest, where they are subjected to a temperature of 220° F., or thereabouts, for 2 or 3 hours. On removal they are placed on tables to cool and drain for 5 or 6 hours, when they are packed in tin cans suitable for market, and the cans are then filled with oil, after which the covers are soldered on. The cans and their contents are heated in a steam chest for a length of time depending on the size of the fish, then vented, when the cans are ready for labeling and boxing.

In 1873 the American Sardine Company prepared about 30,000 dozen cans in the manner above described, and several other factories were also engaged in this business in the same locality.* During the last fifteen years, however, menhaden have not been used for the preparation of sardines in this country, herring having been found much more suitable for this purpose.

FOREIGN SARDINES.

The importation of sardines into this country was begun about 1836. By 1858 it had reached a value of $250,000 annually, and from that year to 1898 it aggregated $29,867,457. The great bulk of these came from France, with much smaller quantities from Portugal, England, and Norway.

The general method of preparing these fish in France is as follows: On arrival of the fish at the factory they are placed on tables or platforms and lightly sprinkled with salt, just enough salt being used to prevent the fish from becoming slimy. The heads, tails, and intestines are removed, and the fish are immersed in weak brine for 1¼ to 2 hours, when they are thrown into small baskets and rinsed in clear water. Next they are placed on small gridirons, and again rinsed and laid aside to dry. The drying is best done in the open air, but when the weather prevents it is done in a specially prepared oven. As soon as sufficiently dry the fish are cooked in oil and then packed with olive oil in tin boxes and cooked and vented, as in case of the Maine sardines.

In France sardines in oil are sometimes mixed with truffles. They are also prepared with tomatoes and sent in small quantities to the New York market, but the chief export in this form is to Mexico. Sardines preserved in butter are quite good, but the butter is generally of inferior quality, and it is necessary to remove it before serving the sardines, and the box must be heated to melt the butter, so that each fish may be removed entire. Sardines preserved in vinegar require to be washed before serving. The addition of oil renders the fish more palatable, though the sardine retains the taste of the vinegar and its flavor is partly destroyed.

Boneless sardines (put up at Concarneau and Davorneney, France) are quite popular in the United States markets, but they are not prepared in this country. The method of preparing them is only a slight modification of the general process. When the sardines are about half dried in the sun (if dried in an oven they can be

*Report of U. S. Fish Commission, 1877, pp. 137-138.

SARDINE CANNING.

INTERIOR OF ICE-AND-SALT FREEZING-ROOM ON PACIFIC COAST, CONTAINING SALMON AND STURGEON. (See page 382.)

boned only with difficulty and loss), the backbone is broken with a pair of pincers near the root of the tail; then by evenly and tightly squeezing it with the fingers it is loosened along the entire length. By this manipulation the whole bone system is loosened, and, commencing at the neck, by the use of a pair of pincers the backbone and the connecting bones can be readily removed.

The present unsatisfactory condition of the Maine sardine industry suggests the advisability of preparing the fish after the manner of the Norwegian smoked sardines. The fish used in Norway is the sprat (*Clupea sprattus*), which is very much like the small Maine herring (*Clupea harengus*); but among the sprat the seines catch many herring (*Clupea harengus*), which are treated in the same manner as the sprat. The industry is prosecuted along the southern and southwestern coasts of Norway and is centered at Stavanger. When the Norwegians began canning these small fish they copied the French methods and put up a product somewhat like the Maine sardine on the market at the present time. But the fish lacked the delicate flavor necessary for competition in Europe with the products of France and Portugal, and in order to cover up the herring flavor they tried smoking them. The quality of the article proved exceedingly satisfactory, and the output now amounts to several hundred thousand cases annually. The method of preparation is as follows:

The fresh fish, as soon as practicable after capture, are put into strong brine for 4 or 5 hours, and then strung on a small iron rod, drained and dried in the open air. They are next placed in the smokehouse, where they are dried for a few minutes by lightly warmed smoke, the temperature not exceeding 100° F. Then the fires are increased and the fish are hot-smoked, being cooked without breaking the skins, so as to hold all the juices. The completion of the smoking is determined by pressing the flesh of the fish, which should separate into flakes. The cutters then remove the heads and tails and pass the fish to the packers. The latter assort and put them in the cans with olive oil, after which the cans are soldered. In steaming, a large number of sardine cans are placed at one time in the cooking tank, where they remain from 20 to 30 minutes, and are then removed and the air-hole soldered. They are next again steamed for a few minutes, cleaned and labeled. Before selling, the cans must remain for 2 or 3 months in storage, so that the oil may have sufficient time to penetrate through the flesh.

As a result of his investigations into the French methods of preparing sardines in oil and his subsequent experience with the preservation of pilchards in Cornwall, Mr. C. E. Fryer, inspector of fisheries for England and Wales, makes the following suggestions for the preparation of sprats (*Clupea sprattus*), which in many particulars resemble the small herring of Maine:

The fish should be landed in as fresh a state as possible, spread on the floor, and sprinkled with salt. They should then, without delay, be beheaded and gutted (all bruised fish being rejected), thoroughly washed, and immediately placed carefully in vats, with a thin layer of coarse British salt between each layer of fish. Here they should remain for 1 or 2 hours, after which they should be taken out, again washed, and ranged in specially prepared wire baskets (*grilles*) to dry.

One great object to be aimed at is to handle the fish as little as possible, and to pass them through the preliminary stages with all speed. With this object the baskets into which the fish are thrown by the "gutter" should be of a size to be easily handled, and should be constructed of open wickerwork, so that the fish in them can be effectually washed by merely plunging the baskets into an open tank plentifully supplied with fresh water. The wire drying baskets are so contrived that the fish will not need to be touched by the hand again after they are once placed in them till they are ready to be packed in the tins. As the wire receptacles are filled with fish they are ranged in the sun, or

under shelter in a dry atmosphere in wet weather, and in a free current of air, till the fish are thoroughly dry. The *grille* is then taken to the cooking stove. This consists of a series of shallow pans (each large enough to hold a *grille* full of fish) containing boiling olive oil, in which the fish are cooked. This will take from 2 to 3 minutes, according to the size.

After standing a minute or two, to allow the superfluous oil to drain off, the *grille* is hung up to cool, when the fish are ready to be tinned. In the bottom of the tin a piece of bay leaf and a clove head or allspice (pimento) seed are placed, 2 or 3 hands being specially told off to prepare the tins and pass them on to the packers, who carefully but firmly place the fish in the tins in layers, with their tails right and left alternately. The tins are next passed to the oil fillers, who fill them up with cold olive oil. After standing sufficiently long to enable the oil to settle down into all the interstices, and filling up, if necessary, the tins reach the hands of the tinmen or solderers, who fasten down the lids. This operation requires the greatest care, and is the only one (except the analogous one of making the boxes) which calls for the services of skilled workmen. All the other operations of working and packing, etc., require neatness and dispatch, but need no technical skill; but the smallest air-hole left by the solderer in the joint of a tin will spoil it.

After closing down, the tins are collected in a crate and lowered in a large boiler, where they are kept boiling for 2 or 3 hours, according to size. This operation serves a triple purpose—it completely cooks and softens the fish, it expels any remaining air from the tins, and it proves whether or not they are hermetically sealed. On emerging from the boiler, all the tins are bulged, but as they cool they naturally contract, the top and bottom of the tin becoming slightly concave. Any tins, however, which have been imperfectly soldered remain bulged and are spoiled. A rub in sawdust will cleanse the tins, when cool, and they then are ticketed (unless made of decorated tin plate) and packed in wooden cases ready for the market.

Having thus described in general outline the method of preserving fish in tins *à la* sardine, I may perhaps usefully refer to two points of detail which it would be well to observe in the arrangement of any factory established for its adoption.

The buildings should be so arranged that the fish can find their way directly from the hands of those who perform one stage in the process into the hands of those who complete the next stage. When necessary, an arrangement of flues from the cooking range and boiler (and oven from the soldering room) may be made to utilize the waste heat to assist the drying process. The tables on which the *grilles* are allowed to drain after cooking, and those at which the operation of "oiling" the boxes is carried on, should be covered with tin plate and fitted with gutters and collectors for saving waste oil, which is marketable. The oil should be stored on the floor above and conveyed to the "oiling" tables through a series of pipes with taps, so that the supply may be under immediate control. Only olive oil of the best quality should be used. Oil of a second quality may be used for working purposes. Olive oil adulterated with cotton-seed oil, or even the latter alone, is often used in preparing French "sardines," but for the best brands the best olive oil only is employed. This is the most costly item in the whole process of manufacture. In cooking the fish, care should be taken to renew the oil before it becomes thick or discolored.

For soldering the tins the only special apparatus required consists of an ingenious but simple turn-table revolving on a pivot and furnished at the top with a "cage," into which the tin fits closely while the top is being soldered. A footplate at the bottom enables the workman to rotate the table at will while, with the soldering iron in one hand and a thin stick of solder in the other, he rapidly closes the "joint" between the body of the box and the lid. As already stated, this operation is the crucial one in the whole process of preparation. In order to keep a check on different workmanship, it is usual to pay the tinmen so much for every 100 boxes "made" and "soldered down," and to deduct so much for every tin that remains bulged after boiling. As a means of identification, each workman marks the tins he makes and the lids he solders down with a special mark, and it is easy for the foreman, when examining and counting the tins, to check the number turned out by each workman and to trace to its author every flaw that leads to the rejection of a tin.

Other methods of making and closing tins are being introduced, and in this and various other details the process of preparing fish *à la* sardine is open to modification. The system above described, however, is that commonly adopted in France, and was successfully applied by me to the preparation of pilchards in Cornwall. In some French sardine factories the fish are baked in hot ovens, instead of being boiled in oil. Occasionally, again, the fish, whether baked or boiled in oil, are soldered down as soon as packed, without the addition of oil in the tins. Sometimes the fish are not subjected to any

preliminary cooking, but are packed as soon as dry and thoroughly cooked by prolonging the operation of boiling in the tins. How far sprats can be treated in this and other various ways can only be determined by actual experience. The exact length of time during which they must be subjected to the several operations of salting, cooking, and boiling, and the proper proportions of spice, etc., will depend on the size of the fish, the size of the tins in which they are packed, and other considerations which must also be determined by careful experiment. That sprats can, however, be preserved in tins *à la* sardine is proved by the fact that at least one factory of the kind already exists on the southeast coast of England, and a ready market can no doubt be found for a largely increased supply abroad, if not at home, and more particularly in India and in our southern colonies, where supplies of fish are scarce. But owing to the shortness of the sprat season no curing establishment could probably afford to be dependent solely on the supplies of this one fish. During a great part of the year the tinmen would no doubt find continuous employment in making the tins in anticipation of the curing season; but it would be found economical to keep the other hands at work in the tinning of other kinds of fish in their season. In Scotland, herrings, hake (in slices), cod, ling, and other kinds of fish, besides crabs and lobsters, would no doubt readily lend themselves to modifications of the mode of cure above described. The tinning of vegetables also serves in Cornwall and in France to keep the works going at times when fish are scarce.

Considerable quantities of young herrings are, I believe, taken at certain times in the garvie or sprat nets. This admixture of the two species has the effect of reducing the value of the catch under ordinary circumstances, but there is every probability that young herrings would make a valuable article of food if preserved *à la* sardine; and as each fish has to be individually handled in the process of cure it would probably not be difficult to distinguish the herrings from the sprats and "tin" them separately. On the other hand, it could be easily ascertained by experiment whether for the purpose of preparation in tins any such separation would be necessary.

It will be understood that there are various circumstances under which the application to sprats of the French system of preserving sardines must be attended with disadvantage. In the first place, the sardine season in France is in the summer months, when the fish can be readily dried without artificial heat. In Cornwall the pilchard harvest takes place later than that of sardines in France, and toward the end of the season the occurrence of rainy or damp weather is a great drawback. The sprat season is later than either, and the provision of artificial means of drying the fish will become more necessary. On the other hand, the heat of a French or Cornish summer is a disadvantage as compared with the comparative coolness of the weather at the time of the sprat harvest, while the sprat has the additional point in its favor that it is less delicate, and will stand carriage and handling better than the sardine. The bones of the sprat, however, are much harder than those of the small immature sardines generally preserved in France. The bones of the pilchard (which is an adult sardine) are much harder than those of its French relative, and those of the sprat are probably harder still. This is one of several points which must be taken into consideration in any proposal to place tinned sprats into competition with tinned sardines. The greater cheapness of sprats will, no doubt, be a question of some importance in determining the issue of such competition. (Fifth Report of Fishery Board for Scotland, pp. 218-221.)

CANNING EELS.

At several of the canneries on the Atlantic coast small quantities of eels are prepared each year. The extent of this branch of the canning trade has been limited on account of the small demand for the product and the scarcity of eels in those localities in which the process has been tried. For this purpose the salt-water eels from the Gulf of Maine are used and especially those from Washington County, Me., and Barnstable County, Mass., and small or medium sized ones are selected. After the head, skin, and viscera are removed, the eels are cut in suitable lengths and placed on wire trays and cooked in a steam retort, or, in some cases, fried in an oven for 20 or 30 minutes. They are next placed in cans, either plain with a small amount of jellies to hold them firmly together or with a sauce made of vinegar and spices. The cans are either tall round, large oval, or similar in shape to those in which sardines are packed. Canned eels are prepared principally at Eastport and Camden, Me., and

New York City. With a cannery located on some portion of the United States coast where eels are abundant and the demand for other purposes limited, as at the mouths of some of the rivers emptying into the Chesapeake Bay, it seems probable that an important and profitable business could easily be developed.

There is a small output in New York City of smoked eels in cans. These fish are eviscerated and smoked in the usual manner, with head and skin on (see page 504), after which they are cut into 6 or 8 inch lengths, or slightly less than the height of the can, and these pieces placed close together in the cans, the interstices being filled with diluted cotton-seed oil suitably flavored with vinegar, cloves, etc.

MISCELLANEOUS CANNING.

HERRING.

Owing to the scarcity of mackerel on the United States coast, and the consequent high cost of canned mackerel, herring are frequently used as a substitute therefor, it going on the market under the brand of "herring mackerel," "blueback mackerel," etc. The method of preparation differs in no particular from that applied to the mackerel. The principal factories for their preparation are on the Maine coast, and the product amounts to about 20,000 cases annually. Herring are also put up in spices, in mustard sauce, and in tomato sauce, the output approximating 12,000 cases annually, and the process of canning is substantially the same as that applied to mackerel. These fish are usually branded "brook trout."

MENHADEN.

At several canneries on the Maine coast menhaden have been canned and placed on the market in 1-pound cans as "ocean trout," "herring mackerel," "blueback mackerel," etc., and have met with ready sale at about 65 cents per dozen cans. In 1889 378,272 cans of menhaden were prepared in Maine, but since then these fish have been so scarce on that coast that comparatively few are canned.

SMELT.

The canning of smelt was first begun late in the fall of 1879 in Boston. They were thoroughly cooked in butter and packed in 1-pound cans, 5 dozen cans in a case.* This business has been abandoned, and at the present time no smelt are canned in this country. In 1885, when the pack of oil sardines was smaller than usual, owing to the scarcity of small fish suitable for quarter cans, experiments were made in the canning of smelt as a substitute for herring in the manufacture of sardines, but they were found to be dry and hard, and deficient in flavor, and efforts in this line were soon discontinued.†

SMOKED STURGEON.

In the canning of smoked sturgeon the fresh fish are cut into pieces adapted to the size of the can for which they are intended and placed in a wire drum, the cross-section of which is equal to the cross-section of the can. This drum is so arranged that one side or head enters the receptacle, and by means of a spring or clasp is pressed into the drum, thus slightly compressing the contents. While it is subjected to the action of the smoke, and as the fish becomes more and more compact, the movable head will gradually press it against the fixed head, so that the contents take the shape of a disk with comparatively flat sides. The drum is so suspended

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* Fishery Industries of United States, sec. II, p. 198.

† Bull. U. S. Fish Commission, 1887, p. 179.

that it may be turned or rotated from time to time, so that the juice that settles to the bottom is brought to the top and compelled to flow through the mass again, thus retaining it in the flesh. On completion of the smoking the disks of fish are removed from the drum and placed in cans with a small quantity of cotton-seed oil, and the cans are hermetically sealed. On account of the scarcity and the consequent high price of sturgeon during recent years, comparatively small quantities are canned. The product is very palatable and will keep for a year or two under favorable conditions.

HALIBUT.

The generally brisk demand for fresh and smoked halibut has prevented many attempts in New England to preserve them by canning. On the Pacific coast, both in Alaska and in the State of Washington, and at Klawak, Prince of Wales Island, fresh halibut have been canned, but in no great quantities. There is no doubt but that the fish is suitable to be thus preserved.

SPANISH MACKEREL.

In 1879 the owner of an oyster and clam cannery at Ocracoke Inlet, North Carolina, purchased small quantities of Spanish mackerel and put up a few hundred 2-pound cans. Shortly afterwards, at the suggestion of Professor Baird, experiments were made in canning Spanish mackerel at Cherrystone, Va., to ascertain their relative value as compared with other kinds of canned fish. The reports of the canneries were that they are no better than fish of ordinary grades, and that as a canned fish they are inferior to the common mackerel (*Scomber scombrus*).*

GREEN TURTLE.

The canning of green turtle (*Chelonia mydas*) in this country was first begun in 1869 on the coast of Texas at the beef packeries located on Aransas Bay. When these canneries were closed, about 10 years afterwards, a small factory was established at Fulton, on the same bay, for preparing turtle meat in tin cans for market. This cannery was in operation up to 1896, using annually about 1,000 turtles, weighing 250,000 pounds, and preparing about 40,000 two-pound cans of turtle meat and 800 two and three-pound cans of "turtle soup." On account of the increasing scarcity of green turtle on the Texas coast, the cannery has not been in operation since 1896.

Small quantities of green-turtle meat are incidentally canned at times at various other places. Each cannery uses methods peculiar to itself, so that it is scarcely practicable to describe any general method of preparing this product. To prepare it so that it will keep a suitable length of time, requires close attention and the greatest cleanliness.

GIANT SCALLOPS.

The Bulletin of the U. S. Fish Commission for 1889 contains the following account of experiments in canning the giant scallop (*Pecten magellanicus*):

> About 1876 the Castine Packing Company undertook to put scallops on the market in a canned condition, as is now so commonly done with clams in many localities on the coast of Maine. It is said that the company was unable to properly preserve the thick, solid meats, and the effort was abortive. Six years ago, however, the attempt was renewed and was in a measure successful. It was found that by previously frying the meats they could be canned without difficulty, but the method was considered too costly and was not put to much practical use.†

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* Report U. S. Fish Commission, 1880, p. 414; 1881, pp. 221–227.
† Bulletin of the U. S. Fish Commission for 1889, p. 320.

CODFISH BALLS, ETC.

In 1878 the preparation of codfish balls was begun by a Boston canner. This product consists of codfish and potatoes cooked with beef tallow, with the addition of a small quantity of saltpeter, the whole being hermetically sealed in tin cans. The usual method of preparation is as follows: For 100 pounds of salt codfish, 125 pounds of potatoes, 10 pounds of raw onions, and 13 pounds of pure beef tallow are required The fish are soaked in tepid water to remove the salt and then reduced to a pulp; the potatoes are boiled, skinned, and mashed; and these ingredients are warmed and mixed thoroughly with the chopped raw onions and beef tallow, adding 6 pounds of saltpeter and 6 ounces of pepper or other suitable flavoring condiments. While the ingredients are being mixed they are chopped as fine as practicable by machinery. The warm mixture is then placed in 1, 2, or 3 pound tin cans and sealed. The cans and contents are boiled at a very high temperature for 2 or 3 hours. On cooling and labeling the product is ready for market. In 1879, 11,000 cases, equivalent to 264,000 two-pound cans, were prepared by Boston canners, the value of which was $38,500. The present annual output is somewhat less, owing to the increased popularity of boneless codfish.

Among numerous other fishery products preserved in cans are clam chowder, fish chowder, Finnan haddie, smoked lake trout, smoked pike, smoked carp, caviar, etc.

The following summary shows some of the varieties of canned fishery products on the New York market and the average wholesale price in 1898:

Designation.	Price per dozen.
Carp, silver, smoked, one-pound cans	$2.50
Caviar:	
Quarter-pound cans	1.85
Half-pound cans	3.15
One-pound cans	5.10
Two-pound cans	9.20
One-eighth-kilo. cans	2.10
Quarter-kilo. cans	3.90
Half-kilo. cans	7.00
Clams:	
Eastern, soft-shell, one-pound cans	.90
Eastern, soft-shell, two-pound cans	1.45
Little-neck, hard-shell, one-pound cans	1.00
Little-neck, hard-shell, two-pound cans	1.90
Clam chowder, two-pound cans	1.50
Clam chowder, three-pound cans	2.00
Clam juice, two-pound cans	1.35
Codfish balls, two-pound cans	1.30
Crab meat, one-pound cans	1.75
Crab meat, two-pound cans	2.75
Crabs, deviled, one-pound cans	2.25
Crab soup, imported, one-pound cans	3.50
Crab soup, imported, two-pound cans	6.50
Eels, in jelly, one-pound cans	1.60
Eels, in jelly, two-pound cans	2.62
Eels, in jelly, five-pound cans	6.25
Eels, Hamburg, one-pound cans	2.25
Eels, Hamburg, two-pound cans	3.20
Eels, Hamburg, five-pound cans	7.50
Eel soup, imported, one-pound cans	3.25
Eel soup, imported, two-pound cans	6.00
Finnan haddie, one-pound cans	1.05
Finnan haddie, Scotch, one-pound cans	1.75
Green-turtle meat, one-pound cans	10.00
Green-turtle soup, one-pound cans	8.00
Herring:	
Domestic, fresh, one-pound cans	.95
Domestic, bloater, one-pound cans	1.10
Scotch, fresh, one-pound cans	1.40
Scotch, kippered, one-pound cans	1.50
Scotch, in tomato sauce, one-pound cans	1.40
Yarmouth bloaters	2.25
Bismark, three-pound cans	2.75
Kieler sprotten, 1½-pound cans	6.00
Kieler sprotten, three-pound cans	10.00
Lake trout, smoked, one-pound cans	2.50

Designation.	Price per dozen.
Lobsters:	
One-pound cans, tall	$2.70
Half-pound cans, flat	1.70
One-pound cans, flat	3.15
Pickled, one-pound cans	2.20
Pickled, two-pound cans	3.45
Mackerel:	
Genuine, one-pound cans	1.15
"Herring mackerel," one-pound cans	.70
Soused, three-quarter-pound cans	1.10
Mustard, three-quarter pound cans	1.05
Oysters, standard, one-pound cans	.70
Oysters, standard, two-pound cans	1.30
Pickerel, smoked, one-pound cans	2.50
Salmon:	
Columbia River, half-pound cans, flat	.80
Columbia River, one-pound cans, flat	1.45
Columbia River, one-pound cans, tall	1.40
Alaska, red, one-pound cans	1.15
Alaska, medium, one-pound cans	1.10
Alaska, pink, one-pound cans	.90
Alaska, sockeye, one-pound cans, tall	1.15
Alaska, sockeye, one-pound cans, flat	1.20
Sardels:	
Half-pound cans	2.00
One-pound cans	3.75
Shrimp, one-pound cans	1.75
Sturgeon:	
Pickled, one-pound cans	1.90
Smoked, one-pound cans	2.20
Terrapin meat, one-pound cans	8.00
	Price per 100 tins.
Sardines:	
Oils, domestic standard, quarters	$2.85
Oils, domestic extra, quarters	3.25
Oils, imported, quarters	6.25
Oils, choice, quarters	9.00
Oils, domestic standard, halves	4.70
Mustards, quarters, small	2.75
Mustards, quarters, extra large	3.00
Mustards, three-quarters	5.25
Spiced, quarters	3.35
Spiced, three-quarters	5.20
In tomato sauce, quarters	3.25
Norway smoked, quarters	8.50

INTERIOR OF FISH CANNERY AT PROVINCETOWN, MASSACHUSETTS.

PREPARATION OF FISH EGGS FOR FOOD.

The roes or eggs of fish are among the most valuable of the miscellaneous food products of the fisheries. The most important are the roes of the sturgeon, mullet, herring, shad, whitefish, cod, and haddock. Some of these eggs are sold to the consumers while fresh, especially the eggs of shad, river herring, whitefish, and haddock. In pickling sea herring the roes are usually left in the fish and no special treatment is applied to them. The eggs of the sturgeon, mullet, and of a few other species are nearly always removed from the fish and separately prepared, and it is to the treatment of these that the present chapter more particularly relates. Sturgeon eggs are salted in brine and sold under the name caviar, the domestic product approximating 300,000 pounds annually, worth $225,000. Mullet roes are dry-salted or pickled in brine all along the United States coast from North Carolina to Florida. The Indians of the Northwest coast dry considerable quantities of roe from various species of fish, the product being stored for winter use, when it is pounded between two stones, immersed in water, and beaten with wooden spoons into a creamy consistency, or it is boiled with sorrel and different dried berries and molded in wooden frames into cakes about 12 inches square and 1 inch thick.

CAVIAR.

Caviar is made from the eggs of sturgeon or similar species of fish, which are suitably salted and held in tight packages in brine. It is the most costly food product obtained in the United States fisheries, and while highly relished by many persons, a liking for it must usually be acquired. For many years the manufacture of caviar was monopolized by the Russians, most of it being prepared on the Volga River and Caspian Sea, where large quantities are even now annually put up, the trade centering at Astrakhan. The product in Russia amounts to about 8,000,000 pounds annually, and it is in great demand in Europe, especially in those countries bordering the eastern half of the Mediterranean.

The abundance of sturgeon in the United States led to the preparation of caviar on the Hudson River about 1850, and three years later on the Delaware River. It was prepared at Sandusky, Ohio, first in 1855, and soon afterwards its manufacture was begun at other points on the Great Lakes and the various rivers on the Atlantic coast; in 1885 its preparation extended to the Columbia River on the Pacific coast, and subsequently to Lake of the Woods. An acquaintance with its peculiar process of manufacture became of considerable value, sums ranging from $100 to $500 being frequently paid for instructions in the secret method. At present, on account of the high price at which the article sells—from 50 to 90 cents per pound—every locality in America in which sturgeons abound is vigorously fished, and on the Delaware River female sturgeons with ovaries in suitable condition sell ordinarily for $10 each, and as high as $60 worth of products has been made from one fish.

The best caviar made in the United States is from the eggs of the lake sturgeon (*Acipenser rubicundus*), these being larger than those of the common species (*A. sturio*). The latter is the sole source of caviar produced on the Atlantic coast, the short-nosed species (*A. brevirostris*) not being found in sufficient quantities for this purpose. The lake caviar sold in 1898 for about 80 cents per pound, whereas the Delaware product sold for 60 cents, and the Southern Atlantic for 50 cents per pound.

The caviar prepared on the Pacific coast is from the *A. transmontanus*, and sells usually for 40 cents per pound. During the past three or four years the eggs of the shovel-nose sturgeon (*A. scaphirhynchus*) have been used to a small extent for making caviar, most of this product coming from the Mississippi River, especially in the vicinity of Memphis. This caviar is not choice and usually sells for about 30 cents per pound, or half that of Delaware caviar.

The increasing scarcity of sturgeon and the high price of caviar have led to many attempts at finding a substitute for sturgeon eggs, but so far with very little success. The eggs of horseshoe crabs (*Limulus polyphemus*) have been used, but they are small, and become hard and tasteless when salted. Garfish eggs have also been tried, and while of good size, they are without flavor and have a disagreeable and even repulsive odor. The most successful substitute yet found is shad eggs, which have been prepared in identically the same manner as those of sturgeon and mixed with the latter. The resulting product sells for a lower price than caviar made entirely from sturgeon eggs, but the decreased value is more than counterbalanced by the increased quantity.

The product of caviar in the United States amounted in 1898 to about 2,800 kegs of 125 to 160 pounds each. Of these, 400 kegs were of the large-grain variety from the Great Lakes, Lake of the Woods, Lake Winnipeg, etc.; 100 kegs from Columbia and Fraser rivers; 200 kegs, of small grain, from the South Atlantic coast, and the remaining 2,100 kegs, of the medium-grain variety, from the Delaware, south coast of Long Island, and other waters of the Middle States. About 500 kegs were consumed in this country, the remaining 2,300 being exported to Europe.

Small quantities of caviar are imported into this country annually, the supplies coming from the Volga and the Elbe. The wholesale price in New York varies from 80 cents to $4 per pound, depending on the quality of the grain and the extent to which it has been salted. The higher-priced varieties are very lightly salted and must be kept at a low temperature.

The equipment for making caviar is simple and inexpensive, consisting, in addition to the floats, slaughter-house, etc., necessary for handling sturgeon meat, of several sieves with wire meshes, a few large-sized buckets, tubs, and a number of tight kegs for holding the product. The first step in the process is to remove the roe from the sturgeon, which should be done as soon as practicable after the fish is caught. The sturgeon is turned on its back or side, a gash is cut from the neck to the vent, and the eggs are removed. Care must be taken to avoid bringing the eggs in contact with fresh water, since it softens them and breaks the shells. The quantity of roe removed from each fish varies considerably. The Delaware sturgeon yield from 6 to 12 gallons, including the investing membranes of the ovaries and the supporting tissues, the latter being only a very small part of the organ, so that there is but little waste from this source. The Columbia River sturgeon yield nearly as much as the Delaware sturgeon, but those from the Great Lakes average only 2 or 3 gallons.

The masses of eggs and membranous tissue are at once placed upon a wire sieve, the meshes of which are just large enough for the eggs to pass through as the masses

are rubbed back and forth by the workman's hand. A tub, can, or box is placed under the sieve to receive the eggs as they pass through. It is convenient, where much caviar is prepared, to fit the sieve over a zinc-lined trough, about 18 inches deep, 2 feet wide, and 4 feet long, with its bottom sloping to one end, where an outlet is arranged. As the eggs are gently pressed by the hand and worked back and forth across the meshes, they become separated from the membranous tissue and from each other and fall into the receptacle, whence they are removed and placed in clean half-barrel tubs.

In the tubs the eggs are at once mixed with a compound of Lüneburg salt, 100 pounds of eggs requiring 13 pounds of Lüneburg salt, to which is added 1 pound of "preservaline," a proprietary composition of certain antiseptics, such as boracic acid, salicylic acid, etc. The Lüneburg salt costs about $4 per cask of 300 pounds, and the preservaline costs about $19 per 100 pounds. The preservaline has been in use for about twelve years, and since it gives satisfaction and costs only a trifle compared with the value of the caviar, no disposition exists to experiment with a substitute. The mixing of the eggs with the salt is accomplished by gently stirring the mass by hand for a few minutes. The immediate effect of the salt is to cut the slime or glutinous coating from the eggs and to dry the mass, but very soon its strong affinity for moisture causes it to extract the watery constituents of the eggs, and in 10 or 15 minutes a very copious brine is formed, and upon its surface a frothy substance collects. This is skimmed off and the eggs placed in sieves of a finer mesh, about 8 or 10 pounds of eggs in each sieve. For convenience in draining, these sieves may be placed on a sloping plank, with strips nailed on each edge to elevate them, or in some houses they are placed over an opening in the floor. The draining must be thorough, and requires from 12 to 20 hours.

The process is now complete and the caviar is at once placed in small, clean oaken kegs, which have been thoroughly steamed, with capacity for holding from 125 to 160 pounds. The kegs cost about $1 each, being made of red or white oak or Norway or Oregon pine. The Delaware kegs hold about 125 or 130 pounds, those used on the Great Lakes about 160 pounds, and those on the Columbia River about 145 or 150 pounds. The kegs when filled with caviar should be kept in a cool but not freezing temperature and be allowed to stand for a considerable time, in order that the gas may escape. During this time the caviar settles several inches and the keg should be again filled before being headed up.

Experience is essential to the preparation of a high grade of caviar, as the extent of the salting, draining, etc., depends on the condition of the eggs, the temperature, and the state of the weather. It is usually customary to keep light and dark varieties of roe separate, since mixing the two gives a speckled appearance to the product. In storage the caviar should be held at a low temperature, 38° to 40° F. being found most satisfactory, and under favorable conditions it may be kept for several years.

The principal market for caviar in kegs is New York City. There are numerous buyers at various fishery points on the coast and in the interior, who collect the output of the smaller manufacturers and ship it to New York dealers, who export the greater part of it to Germany. Occasionally a manufacturer on the Delaware may ship his product to Germany direct, but more frequently it passes through the hands of New York dealers.

Caviar is packed in kegs for the wholesale market, and is never handled in any other form of package by the original producer, but a keg holding more than a customer usually desires, the large dealers prepare it in hermetically sealed tin cans for

retail trade. When prepared in this manner it is sometimes subjected to a process different from that employed for packing it in kegs.

In 1875 Max Ams, an extensive dealer in fishery products in New York, devised and patented* a process, which is as follows:

After the eggs have been sieved and salted in the usual manner, except that preservaline is not generally used, they are placed in tin cans, which are immediately soldered and then exposed to water in a gentle heat, which is very gradually increased to not less than 140° nor more than 200° F. The can is then vented and immediately reclosed to retain the caviar in an air-tight package. By this process the salt mixed with the eggs will be combined with the extraneous matter sufficiently to protect it against decomposition and to constitute a protective covering for the eggs. If the temperature be less than 140°, this effect would not be obtained and decomposition would probably ensue; and if the heat exceeds 200°, the essential oils would evaporate and the eggs be left dry, brittle, and tasteless.

The usual size of cans for the retail trade in this country is $\frac{1}{4}$ pound, $\frac{1}{2}$ pound, 1 pound, and 2 pounds. The price received for $\frac{1}{4}$ pound cans is about $1.85 per dozen, and for 1-pound cans $5.10 per dozen. Other sizes sell at proportionate rates.

A very choice product of caviar, which, however, seems to be little known in this country, is the freshly salted eggs. The fresh eggs on removal from the fish are at once mixed with a small quantity of salt and served in that condition within 2 or 3 hours. This makes a delightful dish, quite superior to the usual caviar of commerce. In order to obtain the article in Moscow and St. Petersburg, the living sturgeon are transported from the Volga in tank cars, so that the eggs may be had perfectly fresh.

A special method of preparing caviar was patented in this country in 1851,† which does not appear, however, to have ever been employed to any great extent. This process is as follows:

The roe, being removed from the fish, are squeezed gently by hand in order to remove the individual ova from the membranes by which they are covered. Sprinkle a small quantity of fine salt in a clean tub and place in the tub a layer of ova and a layer of salt, to the extent of 100 pounds of roe and about 5 pounds of salt. When it has remained about 6 hours, pour 6 quarts of strong brine-pickle over the mixture. After 12 hours a like quantity of pickle is again poured over. In from 30 to 50 hours, according to the state of the weather, the ova will rise or float on the pickle, while certain refuse matter will settle to the bottom of the tub, the extraneous matter being separated from the ova by a process similar to fermentation. The ova are then spread about half an inch thick on sheets, and are exposed to the air from 20 to 40 hours, being turned over in the sheets in the meantime 4 or 5 times a day. When dry, mix with it about 2 ounces of black pepper and 3 pints of oil extracted from the liver or milt of the male sturgeon, the purpose of the oil being to restore to the roe the sturgeon flavor removed by the salting process. Let it stand for 10 or 12 days and then pack in kegs for market.

RUSSIAN METHODS OF PREPARING CAVIAR.

Large quantities of caviar are manufactured in Russia, especially in the vicinity of the Caspian Sea, not only from the eggs of sturgeon but of various other species. Of the sturgeon caviar two kinds are prepared, (1) fresh or grained, and (2) hard or pressed caviar; the former is more valuable than the latter, selling at Astrakhan from $21 to $25 per pood (36.112 pounds), while pressed caviar sells at $15 to $17 per pood. The method of preparing each kind is as follows:‡

In preparing by either method the roe of the sturgeon is spread on a net stretched on a wooden frame and with narrow meshes forming a sieve. The grains are passed through the meshes by slightly pressing the whole mass with the hand till nothing remains on the sieve but the cellular tissue, the

* Letters Patent No. 169668, November 9, 1875. † See Letters Patent No. 7895, January 7, 1851.

‡ See Notice sur les Pêcheries et la Chasse aux Phoques dans la Mer Blanche, l'Océan Glacial et la Mer Caspienne. Par Alexandre Schultz, St.-Pétersbourg, 1873. Also Rapport sur les Expositions Internationales de Pêche, par J.-L. Soubeiran. Paris. 1871.

fat, and the muscle, the grains falling into a wooden receptacle placed underneath. If grained caviar is to be made, the roe is sprinkled with very clean and fine salt, and the whole mass is stirred with a wooden fork having eight or ten prongs. The quantity of salt required varies, according to the season, from 6 to 15 pounds per 100 pounds of roe; more salt being required in warm than in cold weather. It is desirable that as little salt be used as is absolutely necessary for preserving the caviar. The roe mixed with salt first presents the appearance of dough when stirred, but when each grain has been impregnated with salt the whole mass swells, and in stirring a slight noise is perceptible like that produced by stirring grains of corn. This noise is a sign that the process is completed. The caviar is packed in casks made of linden wood, as this imparts no disagreeable flavor to the contents.

For manufacturing pressed caviar a tub half filled with brine is placed under the sieve, the strength of the brine varying with the temperature and the season. To impregnate the grains evenly with brine the whole mass is stirred with a wooden fork, always turning it from the same side. This is continued for 10 minutes in summer and about half that long in winter. Then the roe is removed with fine sieves and, after the brine has drained therefrom, it is put in receptacles made of the bark of the linden, 3 poods (108 pounds) to each sack, each of which is placed under compression to remove all the brine from the roe and to transform it to a solid mass, remaining under compression for about 6 days. During the pressing many grains are crushed and a portion of their contents flows out with the brine, the loss in weight amounting to about 30 per cent. The pressed caviar is then removed from the sacks and packed in casks containing usually 30 poods (1,080 pounds) each, the inside of which is covered with "napkin linen," this being the reason why the caviar is frequently called *caviar à la serviette* (napkin caviar). The finest quality of pressed caviar, that which has been least salted and pressed, is packed in straight linen bags of cylindrical shape, and is called *caviar à sac* (sack caviar). Caviar is also shipped in hermetically sealed tin cans.

Mr. Schultz states:

The fatness of the roe depends on the quality of the fish and the season when it is caught. The fattest is that made from the roe of sturgeon caught in the Caspian between July 8 and August 15. This roe is left only a few hours in the brine and then taken out and packed, without being pressed, in casks holding from 5 to 10 poods (180 to 360 pounds) each. If the fish has been dead so long that the roes are somewhat spoiled, the roes and ovaries are placed in the brine until they are thoroughly impregnated with salt and then pressed and packed in large casks containing about 1,000 pounds. This is sold at a very low price, from 5 to 8 cents per pound, wholesale.

The choicest caviar in the Russian trade is from the roe of the bélouga (*Acipenser huso*), the eggs being large and of good appearance; but for the bulk of caviar the roe of the common sturgeon (*A. guldenstädtii*) and of the sévriouga (*A. stellatus*) is used. Choice caviar is made from the eggs of the steriad (*A. ruthenus*), which, however, does not enter into commerce, being used by the fishermen and their neighbors.

The eggs of the bream (*Abramis brama*), of the perch (*Lucioperca sandra*), and of the "vobla" or chub (*Leuciscus rutilus*) are also used for making a form of caviar, which finds a market principally in Constantinople and Greece. Merchants from Greece visit the fishing establishments near Astrakhan, purchase the fresh eggs, and have the caviar prepared under their own supervision in a manner quite similar to the salting of mullet roes in the United States. The roe bags with the eggs therein are carefully removed and mixed with dry salt in bulk. After sufficient salting the mass is placed between boards weighted down by heavy stones, and after remaining thus for a month is shipped in casks. In the retail trade it is usually cut into disk-like slices and is much sought after in Greece. From 500,000 to 700,000 pounds of the caviar from perch eggs are prepared every year in Kuban. During recent years the Greek Islanders have prepared large quantities of roes from the above-named species of fish.

Day states* that the roe of carp (*Cyprinus carpio*) is made into caviar by Jews in Italy and Eastern Europe, as by their regulations they may not eat caviar made of sturgeon, that fish being destitute of scales.

* The Fishes of Great Britain and Ireland, by Francis Day, vol. II, p. 162.

The fishermen of the Dardanelles prepare a kind of cheese from the roe of several species of fish by drying it in the air and then pressing it. By dipping it in melted wax, a crust is formed over it which prevents its being affected by the air. Inside this crust the roe undergoes a sort of fermentation, giving it so piquant a flavor that one can eat but little of it at a time. It is said to taste like a mixture of fine sardines, caviar, and old cheese. Before it is eaten, the crust of wax is taken off, and if it has become moldy, which frequently happens, it is soaked in strong vinegar.*

In Germany a form of caviar is made from the eggs of the pike, in the following manner. The fresh eggs on removal from the fish are rinsed in cold water and rubbed through a coarse sieve to separate them from the membranous tissues enveloping them. On completion of this, they are rinsed two or three times and are placed in a finer-meshed sieve to drain. Next, they are well mixed with fine salt and flavoring ingredients, there being added to each 100 pounds of eggs about 3½ pounds of fine salt, 2½ ounces of citric acid, and a small quantity of lemon oil. After being thoroughly mixed with these ingredients the eggs are put in a cool place, and after remaining undisturbed for eight days the jars or tubs containing them are tightly sealed.

MULLET ROES.

Mullet roes are considered great delicacies in nearly all countries in which this fish abounds, and large quantities are prepared along the southern coast of the United States and in countries bordering the Mediterranean. At maturity, which occurs in September and October, the roe of the Southern Atlantic mullet is from 5 to 8 inches long and 1½ to 2½ inches in diameter. These are saved in nearly all the mullet fisheries of the United States, and are sold either fresh or dried, about 300,000 pounds, worth $20,000, being salted annually on the west coast of Florida.

Dried mullet roes are prepared along the southern coast from North Carolina to Florida, inclusive, in a manner quite similar to the drying of mullet. The roes utilized are from the matured females which have not begun spawning, for as the spawning time approaches the eggs soften and burst the surrounding membranes or roe bags, when they are useless for salting or drying. Nothing but firm roes should be used for salting, and soft roes, roes from fish which have been caught some hours, as well as roes from roe bags half emptied should, if used at all, be salted separately.

In removing them care should be taken to avoid breaking the roe bags or injuring or bruising the eggs, but they should be free from portions of the surrounding viscera. If the tubs in which the roes are gathered have holes through which the water can run off, some salt is saved and a better product is secured, the water making the roes soft and less liable to keep. The roes still in the roe bags are then placed in boxes or barrels with salt sprinkled among them, or in some cases they are placed in brine, where they remain for ten or twelve hours, but the former method is preferred. An excess of salting must be avoided, since it causes the egg-sacs to break and the eggs are ruined on exposure to the sun and to pressure, or they become dark and brittle. If properly treated a good article can be made of roes that have become somewhat soft by salting it immediately on removal from the fish, by using more salt than for the firm roe, or by resalting it. Medium grain salt is preferred for salting. Coarse salt should be avoided, since it is liable to become imbedded in the roe membrane and give

* Norsk Fiskeritidende, vol. v, No. 2, Bergen, April, 1886.

it a burnt look. About 1 peck of Turks Island or Liverpool salt to 160 pounds of eggs usually gives the best results.

On removal from the salt the roes are spread out on boards and exposed to the sun for about one week, being taken in at night to prevent the moisture and dews from falling on them, and every morning they are turned over to thoroughly aid in drying them. Care must be taken to prevent them from becoming wet after the drying has begun, and upon the first indication of a rain they should be placed under shelter. Sometimes after one day's exposure other boards are laid on top of the roes so as to slightly compress them. When properly cured, they are 4 to 8 inches long, 2 to 4 inches wide, and one-half to two-thirds of an inch thick, and vary in color from a yellowish brown to dark red, according to the freshness of the roe, carefulness of handling, degree of saltness, and length of drying. The roes are then sent *en masse* to market in baskets, boxes, or the like, and sold from 40 to 60 cents per dozen, according to the size and carefulness in curing.

In the West Indies and in many countries bordering on the Mediterranean Sea, mullet roes are prepared by methods similar to those employed in this country. In Greece almost the same process is used, except that when dried the roes are generally dipped in melted beeswax. Those obtained from Tunis are very highly esteemed, about 150,000 being sold in Italy each year at about 20 cents each.

Mr. Day states:

> In Italy, the hard roe of mullet is converted into cakes termed bolarge or bolargo, which are prepared by washing and sprinkling with salt and pressing between two boards. This may be smoked or sun-dried and is considered a good appetizer to promote thirst. But in India the same article is somewhat similarly treated and considered excellent for curries.

Readers of Pepys will recall the eating of bolargo in England, as the gossip says:

> Sir W. Penn came out in his shirt on to his leads and there we stayed talking and singing and eating bolargo, bread and butter till twelve at night, it being moonshine, and so to bed very nearly fuddled.

SALTED SHAD ROES.

A small quantity of shad roes are brine-salted in North Carolina, Virginia, and Maryland each year, these being so prepared only when the state of the fresh-fish market or the transportation facilities makes it necessary to pickle the female fish. The roes are removed from the fish in dressing the latter, care being taken not to cut or injure the roe bags. As soon as practicable thereafter they are washed by stirring them with the hands in tubs of water, and are then placed in tubs of strong brine with dry Liverpool salt sprinkled among them and at the top. Every 12 hours during the ensuing 5 days the roes are gently stirred to separate them from each other and to have them uniformly salted. The sixth day they are removed from the pickle, drained, and placed in suitable packages, with dry Turks Island salt sprinkled at the bottom, through the roes, and at the top. The package should then be filled with strong brine made of Liverpool salt. A variety of packages are used, the most convenient being 20-pound kits, which when filled with salted roes sell usually for about $2 each.

EGGS OF COD, HADDOCK, ETC.

It is somewhat remarkable that the roes of cod, haddock, and other ground fish are not more extensively used for commercial purposes in this country. A large trade exists in cod roes in Norway, the eggs being salted and shipped to France to be used

as a bait in the sardine fishery. About fifteen years ago a small trade developed in exporting cod roes from this country for use in the same fisheries. The price received was about $2.75 per barrel net, and the price usually paid in France is about 50 francs per barrel. In 1879–80, 3,200 barrels of cod and pollock roe were salted at Gloucester and shipped to France via New York, but on account of discriminative duties these shipments were soon abandoned. An attempt has been made to introduce cod roe as a bait in the Eastport sardine fishery, but without success.

The only roe now saved in the New England fisheries is that of the haddock, which is brought ashore fresh, especially by the shore vessels, the proceeds from the sale usually going to the cook or to the crew. It is taken principally in the spring, from 35 to 75 pounds being secured for each 1,000 pounds of dressed fish. It is sold at prices ranging from 25 cents to $2.25 per bucket of 25 pounds, and the annual product is about 600,000 pounds, for which the fishermen receive $14,000. It is purchased by consumers while fresh, and does not receive any special method of preservation.

The possibilities for utilizing a part of the roe now wasted in our New England fisheries furnish sufficient reason for incorporating herein the following description of the methods of making cod caviar in Norway:

For the preparation of cod caviar the Norwegians use the whole ovaries of the cod which are salted in barrels, and mostly in the Lofoden winter fisheries. The roe must be salted whole without injuring or breaking the enveloping membrane, and must not be salted too much, just sufficient to impart a nice orange-red color. When the salted ovaries are removed from the barrels they are first thoroughly washed several times in fresh water, and then hung on wires or ropes in the open air, but protected from too strong sunshine. After they have dried about 24 hours they are taken down for smoking. For this purpose they are hung in the same way in the smoking-house on sticks or rods or put on frames covered with old nets or wirework and cold-smoked for two or three days, or until they become of a dark-brown color. After smoking, the enveloping membrane or skin of each roe sack is torn and removed, and the eggs packed in good, tight barrels, which are then tightly closed and placed in a normally cool place for a month or six weeks. At the end of that period the eggs begin to ferment somewhat, which may be detected by the swelling of the barrel. It is well not to wait too long, but to examine the barrels every week or so, and as soon as fermentation has begun a sufficient quantity of salt should be put into the roe, to prevent the product from spoiling.

By the fermentation the roe receives a slight acid flavor and a taste resembling that of fermenting beer or wine, and this fermentation must be stopped by adding salt at a definite point, which is to be learned by experience only. The salt used to stop the fermentation must be of the very best quality, and if the roe seems to be dry a little good French olive oil is added to moisten the product. After the roe has been thoroughly mixed with the salt it is put in 1-pound glass bottles that are sealed with cork stoppers.

FEMALE STURGEON WITH ROE EXPOSED, AND APPLIANCES FOR MAKING CAVIAR, DELAWARE RIVER.

SHED FOR PREPARING CAVIAR ON THE COLUMBIA RIVER.

FOOD EXTRACTS OF MARINE PRODUCTS.

Various methods have been introduced for preparing extracts of the alimentary principles of marine products, especially of those that are otherwise wasted. In Norway and other countries of northern Europe a number of preparations in the nature of pastes or extracts are made from fish. A well-known instance is the fish meal of Norway, which is composed of the flesh of fish reduced to powder, in which all of the nourishing materials are concentrated and condensed, with the addition of certain other substances. It is claimed that it contains 4 times as much nutritious matter as beef, and 16 times as much as milk or rye bread. On the coast of Cochin China, large quantities of a fish paste are prepared from the shrimp and small fish inhabiting the inshore waters. It is stated that this sauce is brought to perfection by being buried in the earth for several years. About $500,000 worth is consumed in the French provinces alone.

EXTRACTS OF FISH.

Following the idea of Baron von Liebig in preparing the well-known article of commerce known as "extract of meat," several attempts have been made to prepare a similar article from fish. In the case of meats, the substances soluble in water are extracted from the tissues, and the albumens are then coagulated by the aid of heat or by the addition of dilute acid. The fluid remaining after the coagulated albumen has been skimmed off consists of the extractives and the salts soluble in water, and this is evaporated down to a semifluid condition, in which it is placed on the market.

In 1876, Stephen L. Goodale, for many years secretary of the Maine Board of Agriculture, introduced a method of preparing a food extract from fish, especially applicable in connection with the use of menhaden for oil and fertilizer. His process, as improved in 1880 and covered by Letters Patent No. 248586, dated October 25, 1881, was as follows:

Clean the fish and boil for a short time to coagulate the albumen contained in the muscle juices. Separate the liquid from the solid matter by drainage and pressure and allow the liquid to stand in a suitable vessel until any oil which may have passed over in the liquid has risen to the surface and been removed. The liquid is then aerated at the highest practicable temperature, either by introducing a current of heated air or of heated steam, or by ebullition with free access of air, when a substance causing turbidity is precipitated, the complete precipitation being ascertained by examining samples taken out from time to time in a glass tube or heater. If gelatine be present in the liquid, which is the case if skins and bones are not excluded in cleaning the fish, the precipitate will be finer and slower in falling than if muscular flesh alone were used. The liquor will also attain a somewhat darker color, resembling that of light wine, and be reduced in bulk by the further concentration incident to the means used to effect precipitation. When the precipitation is completed the precipitate should be removed from the liquid either by drawing off or by filtration in any convenient manner. The clear liquid thus obtained is evaporated, as is customary in making meat extracts, the evaporation to be continued until the desired consistency has been reached, which is usually about that of honey. The product may be put up in cans, bottles, or other closed vessels.

The inventor states that a barrel of menhaden yields about 3 pounds of the extract, that the article compares favorably with Liebig's extract of beef and retains its flavor under any ordinary condition of temperature or climate. While it has never been prepared for the general market, it seems not improbable that it might have a considerable patronage if properly introduced.

A somewhat similar process was invented* in 1882 by Carl Adolph Sahlström, of Jönköping, Sweden, for producing a nutritious extract from the flesh of the shark, whale, seal, and other sea animals. This process was as follows:

The raw material is cut up into as small pieces as possible by mechanical means and is placed in a vat provided with stirring apparatus. A quantity of clean water, free from lime, is boiled and cooled down to from 6° to 15° C., and to this is added so much dissolved hypermanganic alkali as will impart to the water a light-red color (say from 1 to 10 grams for every 100 liters of water) and from 20 to 100 grams of water of ammonia. Sufficient of this liquor is added to the finely cut raw material to give thereto the consistence of thin gruel, and the stirring apparatus is then set to work. After a period of from 10 to 30 minutes the mass is removed from the vat and is placed in a centrifugal apparatus for the purpose of separating the liquor, which carries the fat with it. The inner part of the centrifugal apparatus is preferably covered with cloth. When all the fluid is separated the mass is again soaked in fresh liquor and passed through the centrifugal apparatus, and this is done as often as may be necessary to remove all the fat. All the fluid obtained is mixed together and left to stand in a deep tank for a period varying according to the temperature and until complete separation takes place. The fat and oil rise to the top of the liquid and are removed for further treatment. The oil is separated for special treatment. The solid mass remaining in the centrifugal machine is also reserved for further treatment. The fluid thus obtained, free from any particle of fat, is then mixed with 1 to 10 grams of common salt to each 100 liters of the fluid, is boiled as quickly as possible until the albumen coagulates, and is then filtered. The clear fluid is evaporated in vacuo or otherwise till it attains the consistence of treacle. It is then poured into a shallow vessel, which can be heated by steam. From 0.1 to 8 per cent of sugar is then added, for the purpose of preserving the extract and of imparting a taste thereto similar to that of Liebig's extract of meat. The extract is heated to a temperature of 100° C., and kept constantly stirred until the desired consistence is attained. Vegetables or extracts thereof, or any other flavoring matter, or flour or other material for imparting a higher nutritive power or to give solidity, may be added at pleasure.

A factory was established at Aberdeen, Scotland, in 1885, under the superintendence of Sahlström, in which quantities of the extract were prepared from whale flesh. It was reported that the product possessed no flavor of the crude flesh whatever, and was quite similar to that prepared from ox flesh. It does not appear that anything is done in this line at present.

In a discussion of extracts of fish, published in 1885, Prof. William Stirling, of Owens College and Victoria University, Manchester, states:

The Normal Company, under the superintendence of Mr. Sahlström, has recently established a factory in Aberdeen, and has manufactured large quantities of a similar extract from whale flesh. This extract presents all the characters of an extract made from the flesh of the ox. Such an extract forms an excellent basis for a soup, having all the flavor of an extract of ox flesh. But extracts of fish can be made in a similar way, the product being, as far as sensible characters are concerned, indistinguishable from that of ox flesh. These are points of difference depending on the slightly different chemical composition of fish and flesh; for, even in the same animal, there is a difference in the chemical composition of individual muscles. Such fish extracts have no flavor of fish whatever, and possess all the aromatic flavor of meat extract, and I understand that they can be made much more cheaply than extract of meat. At a certain point in the process of extraction all the fishy flavor disappears. As a general rule, these extracts are made by boiling a watery extract of the fish muscles, after acidulation and precipitation of the proteids or albumins, in an open vessel with a double jacket, so that steam can be admitted between the layers of the jacket, and thus keep up

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* Letters Patent No. 353822, dated December 7, 1886.

ebullition. Such extracts will keep for a very long time, and they are available for all the purposes for which meat extract is available. The question has still to be tested dietetically whether such extracts are in any way superior to those of meat. In any case they are quite equal to meat extracts in stimulating and restorative properties.

Such extracts, however, can also be made from other marine animals, *e. g.*, crabs and shellfish generally. In these cases the extract is so made that it retains the flavor of the crab or shellfish. Thus there may be manufactured on the spot a large amount of extract which undoubtedly has a commercial and dietetic value. In a properly adjusted dietary, however, mere stimulants and restoratives are not sufficient, but there must be a proper amount and adjustment of the proteids (albumins) carbohydrates (such as starches and sugars), fats, and mineral salts. The question arises, then, Can not a cheap and useful food be made so as to combine these substances in proper proportion? The whole order of the legume tribe, represented by peas, beans, and lentils, have a high dietetic value, and this fact was made use of by the Germans in the manufacture of the famous "Erbswurst," or "iron ration," which played so prominent a part in the dietary of the Prussian soldiers during the Franco-German war.

As a matter of fact, in most soups what one obtains is really the extractives and salts and some flavoring materials. The substances in meat which give rise to the sensations of flavor and sapidity are really most important from a physiological point of view, for they excite powerfully the secretion of the digestive juices, and this greatly aids the process of digestion. Hence the value of mixing even highly nutritious food with sapid articles. Every one is familiar with the fact that tasteless articles very soon pall on one's palate, and how nauseating they become after a time. (Fourth Annual Report of the Fishery Board for Scotland, pp. 257, 258.)

With a view to producing a more digestible and nutritious as well as a more economical article of food than the dried cod of commerce, L. M. Haskins, of Boston, Mass., introduced in 1881 a combination of fish flesh, bone, and salt, ground together and desiccated. His process of manufacture was as follows:

The edible composition consists of fish bone and fish flesh ground together with common salt in a mill or between grinding rolls, so as to be reduced to a powdered state and thoroughly mixed or combined. Sixty pounds of the flesh, 20 pounds of the bone, and salt sufficient to give the mixture the requisite savor and preserve it from decay under ordinary circumstances are found to afford in a ground state an excellent edible composition. The proportions of the ingredients of the composition may, however, be varied, as occasion may require, to produce a palatable and suitable article of food.*

The inventor claims that this composition, by containing the alkaline and gelatinous properties of the bone in a powdered state, is not only readily digestible, and, from a sanitary point of view, better as an article of food than salted fish without any osseous additions, but that it can be manufactured and sold at a cheaper rate comparatively. It is well known that wheat or other flour without the admixture of the bran is not so digestible or beneficial as food as it is with a due amount of the bran, the latter containing the constituents necessary to the formation of bone. So this composition, by containing osseous elements in a finely reduced state, is rendered thereby not only easier digested but better as a food, especially when suitably cooked.

The following method of preparing fish meal was introduced by F. B. Nichols and Cathcart Thomson, of Halifax, Nova Scotia, and patented May 1, 1883:

The fish are headed and split and a portion of the backbone is removed in the same manner as for making the ordinary dry-salted fish. The pieces are then washed and all bloody portions removed. Very little salt should, it is said, be used in curing, as heavy salting makes an inferior meal, even when the excess is removed by water previous to drying. For some qualities of meal it is preferred to dry without salt. In this state the fish would soon spoil and very rapid drying must be resorted to in order to save them. The immediate application of currents of hot air would accomplish this, but would render the skin so friable as to defeat the after process and in other respects injure it for making meal, and open-air drying would not be speedy enough to keep the fish from tainting. In order to obviate these difficulties the fish-drying house and apparatus of the patent granted this inventor

*Letters Patent No. 241357, dated May 10, 1881.

December 6, 1881, No. 260382, is employed. The drying must be more thorough than for ordinary dried fish in order to make the fish hard and crisp. The hard-dried fish are made small enough to be fed into the hopper of a mill to be coarsely ground. Almost any kind of grinding mill may be used, provided it is not too sharp and is set high for coarse grinding for the first run. This run should be bolted through sieves having about 144 meshes to the square inch. About 75 per cent of it should pass through the bolt. The remainder, which is too coarse to pass, consists of the bones and the skin with considerable fish flesh adhering to it. In order to utilize this it is reground with the mill set closer and again passed through the bolt. If on examination much fish adheres to the skin it should be subjected to another grinding with a still closer set of the mill and again passed through the bolt. The residue from this, consisting principally of skin, bones, and scales, should not amount to more than 10 per cent of the weight of the dried fish and may be utilized as manure. The product of the last grindings contains considerable of the white portion of the skin, with fragments of bone and enough of the black skin to give a coarse, dirty appearance to the meal. In order to remedy this it should be again ground in a sharper and closer set mill to reduce it to a fine meal, and this, being passed through a bolt having about 400 meshes to the square inch, gives a fine product and contains the most nourishing portion of the fish. The last product can be either used alone or incorporated with the first by uniform mixing.

The inventors say:

We are aware that fish meal has been previously made; but in all previous processes, so far as we are aware, the fish used have been so salt as to require soaking the meal to remove the excess of salt before cooking, and the skin, fins, tail, and larger bones removed before grinding. We propose to use fish dried with little or no salt, and to grind them without removing either skin, bones, or other refuse contained in fins or tail, and to separate them by bolting.

In Europe "pastes" are made of anchovies, bloaters, shrimp, etc., the output being considerable. The following is one of the methods used in preparing anchovy paste. For each gallon of fish take 1 pound of salt, $\frac{1}{2}$ pound of saltpeter, 1 ounce of sal prunella (saltpeter deprived of water of crystallization by heat) and a few grains of cochineal, and pound the whole well together in a mortar. In a stone jar place a layer of the ingredients, then a layer of fish, and so on until the jar is filled, press them hard down and cover up carefully, and let them remain for six months, when the paste is ready for use.

Somewhat similar to the above are the very delicious sardine butter (*Sardellenbutter*), crab butter (*Krebsbutter*), and crawfish butter prepared in Europe. These sell very high, 60 or 75 cents being the usual price for a 2-ounce bottle. Mrs. M. von Eisenhardt furnishes the following process for making crawfish butter:

Remove the meat from 100 boiled crawfish, dry the shells, put them with one pound of butter into a mortar and pound them fine. Then place in a saucepan over a fire and stir 5 minutes, add 2 quarts boiling water and cook for 5 minutes. It should then be strained through a napkin into cold water, and as soon as cold and firm remove it from the water and stir it in a saucepan over the fire for a few minutes, when it is ready for use. It should be placed in small glass jars and stored in a cool place.

In Japan lean pieces of fresh flatfish, eels, shark, etc., are freed from the bones, pounded in a stone mortar, and at the same time mixed with a certain quantity of salt, flour, sweet wine, white of an egg, and sacchariferous algæ (*Laminaria*), until the mixture assumes a paste-like consistency. This mixture is molded into various shapes, such as semicylindric, on a curved wooden plate; hollow cylindric, around a bamboo stick; discoid, on a circular plate, etc. These are heated over a charcoal fire, and then steamed and baked. The product may be kept from 3 to 20 days, according to the amount of the desiccation and the season of the year.

The secret of preparing several choice forms of fishery products has become lost. The method of preparing the *garum sociorum* of the Romans, a kind of fish sauce, is

now unknown. Athenæus and several other ancient writers speak of it in most glowing terms, and Pliny, who states that it is an extract from the entrails of certain fish that had undergone the process of fermentation, further says:

The Greeks, in former times, prepared "garum" from the fish called by that name. The best "garum" comes now from Carthage, in Spain (Carthagena), and is called "garum sociorum." You can scarcely buy two boxes (each containing about 10 pounds) for a thousaud pieces of mouey. No fluid, except scented waters, sells for so high a price, and it is in great demaud by all classes of society. The fishermen of Mauritauia, Betica, and Cartega prepare it from mackerel fresh from the ocean, which alone are fit for this purpose. The "garum" from Klozomene, Pompeii, and Liptes is also highly praised; and the prepared fish from Antipolis, Thurium, and Dalmatia are no less to be recommended. (Pliny, Hist. Nat., XXXI, 8.)

EXTRACTS OF CLAMS AND OYSTERS.

It is generally conceded that clams, both hard (*Venus mercenaria*) and soft (*Mya arenaria*), form one of the most nourishing and easily assimilated of all foods, especially when the hard indigestible portions are eliminated. For this reason there are many preparations of these marine products on the market, possessing excellent medicinal and restorative qualities, making them almost invaluable for invalids or convalescents. In making these preparations the solid matter is usually separated from the liquid and the latter reduced in bulk by evaporation. The extract thus obtained is rich in nutriment, is easily assimilated, and is a valuable tonic for people of weak or impaired digestive organs, and also as an article of food either alone or combined with water, milk, etc. The juices of oysters and other mollusks are also used at times for preparing similar articles, but they do not possess the nutritive qualities of clam extracts.

The first of these proprietary compounds was introduced by Butler G. Noble in 1867,* the extract being prepared in the following manner:

The clams are removed from the shells, rinsed so as to remove grit or sand, cut into small pieces; a small quautity of fresh water is added and the whole boiled for about au hour. The free liquor is theu poured off, the fibrous mass subjected to pressure, and the liquid obtained by this pressure is subjected to a process of evaporation at a temperature not exceeding 190° F., and as much lower as is practicable, uutil it is reduced to a thick paste, which is further reduced to a state of dryness in proper drying chambers. During the process of making, salt, pepper, and other condiments may be added if desired. This extract, which can be made into cakes of any size or reduced to powder, is readily soluble in water and contains the esseutial elements of nutrition and flavor peculiar to the clam. It is recommended that it be used in the making of soup, in flavoring, or for a variety of other purposes in cookery.

A patent† was granted to the same inventor for a similar process of drying the juice or natural liquor of oysters, which in the shucking-houses is generally drained off and thrown away. This waste material was to be reduced to comparative dryness by any of the means of evaporation, and then pressed into cakes or any other desired form. It is stated that a 2-ounce tablet may contain the nutritive ingredients of 4 quarts of fresh oyster juice and produce, with the addition of boiling water, 4 quarts of strong oyster soup, retaining the natural flavor of the oyster, to which may be added some freshly cooked oysters for verisimilitude. It does not appear that either of these processes is now used to any commercial extent.

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* Letters Pateut No. 66616, dated July 9, 1867.
† Letters Patent No. 66732, dated July 16, 1867.

In 1875 Charles Alden introduced a process* of preserving desiccated oysters, clams, etc., for food in combination with vegetable or other alimentary matter. His process is as follows:

The clams or other shellfish are taken from the shell and the natural liquor separated from the meat by straining through a sieve, or by any other convenient means. The body or meat is then desiccated by evaporation to a dry condition, so that it can be pulverized or granulated by crushing or grinding. The liquor, after separating the body or meat of the fish, is strained, to separate impurities, and sufficient bread crumbs or other farinaceous or alimentary material to absorb the whole of it added to the same, after which the mass is desiccated by evaporation in the same manner as the meat of the clams, and, when dry, is pulverized and granulated and added to the desiccated meat. Salt and other desired seasoning substances may be added to the compound, and the whole, after being thoroughly mixed, is put in suitable packages for use.

By this process it is claimed that all the natural elements of oysters or clams are preserved in suitable condition for use in making soups, chowder, fritters, and for other culinary purposes.

Letters patent† issued in 1877 to H. W. Buttles, of New York City, cover a process differing little from Alden's, and consisting in crushing the flesh of shellfish and desiccating it with the juice, then combining the residuum with salt and certain farinaceous substances. The method is thus described by the patentee:

In preparing the clams for desiccation according to this process the meat is reduced to a pulp in its own juice by passing the meat and juice of the freshly-opened clams through a mill constructed on the principle of the "beating engine" used by paper-makers in the preparation of paper pulp from rags, the clam meat, flowing in its juices, being caused to pass between a revolving cylinder armed with knives arranged parallel to its axis, and stationary knives fixed below it, the two sets of knives being so approximated as to readily cut that which passes between them, the pulp being made to circulate in a suitable channel from the knives back again to the opposite side thereof by means of the revolution of the cutting cylinder. Or the clams may be crushed and thus reduced to pulp by means of a wheel revolving in a circular trough, or by means of any of the improved forms of meat-chopping machines known to the art.

Having reduced the clam meat to a pulp in its own juice by any suitable means, substantially as described, it is next desiccated, either by subjecting it to strong currents of moderately-heated air upon revolving cylinders or disks, as in the process for desiccating eggs patented by Lamont, Quick, and others, or by exposing it to a moderate heat in suitable vessels placed in a receiver wherein a vacuum more or less perfect has been produced. In either case the clam pulp must not be subjected to a temperature so high that the albumin in the pulp shall be cooked or in the least coagulated and hardened while desiccating.

The clam meat thus desiccated in its own juices is prepared for market and use by reducing the resultant hard brittle mass to an impalpable powder, and then admixing it with common salt, finely powdered, and with a proper proportion of pure and unadulterated, cooked and uncooked, pulverent farinaceous substance, derived either from cereals, such as wheat flour, or from roots, such as potato starch, a proportion of about 60 per cent of clam, 32 per cent of farinaceous material, and 8 per cent of salt, yielding an excellent product. Or the clam pulp, prepared substantially as above described, may be admixed with bread crumbs, cracker dust, or other farinaceous preparation, before desiccation, in sufficient proportion to form a paste or dough, and the resultant hard, dry compound be reduced to a powder for use.

Another process of desiccating clams and other shellfish was introduced‡ in 1890 by S. G. Van Gilder, of Philadelphia:

In carrying out this method the clams, oysters, or other shellfish are first removed from their shells and separated from their natural liquor by a draining process, accompanied by slight compression, if necessary, to expel all the liquor. After this separation, the meaty portion of the fish is

*Letters Patent No. 168703, dated October 11, 1875.
† Letters Patent No. 191024, dated May 22, 1877.
‡ Letters Patent No. 440519, dated November 11, 1890.

reduced to a finely comminuted, pulpy mass by chopping, grinding, or in any other suitable manner, in which state it is mixed with a portion of the natural liquor previously separated from the fish, and then subjected to a boiling heat—say 212°. After this cooking process the solid matter is again separated from the liquid and the latter combined with what remains of the raw liquor. Then the combined juices are subjected to a boiling and skimming process to remove all superfluous matter and concentrate and refine the liquor. This boiling and skimming process serves to eliminate objectionable matters floating in the liquor and concentrate and cook the juices, so that the resultant product will be more refined and will keep in a prime condition for any length of time. To this refined and concentrated liquor is then added a suitable quantity of some farinaceous substance, such as flour, meal, cracker dust, bread crumbs, etc., after which the whole is subjected to a boiling temperature, which will serve to cook the same and thicken and coagulate the albuminous and starchy matters contained therein. Then this coagulated mass is thoroughly mixed with the pulpy mass, and the whole subjected to a moderate degree of heat to evaporate all the moisture from it, and thereby desiccate it. The heat for the purpose of desiccation may be applied by steam, hot air, the vacuum process, or otherwise, in order that the desiccation may be thorough. After desiccation the product is reduced to a granular form and put up into suitable cans or packages for the trade.

It is claimed that this concentrated food product will keep in a prime condition for an indefinite length of time, and when used for such purposes as soups, chowders, fritters, sauces, dressings, etc., the original flavor will be retained and greatly augmented by concentration.

One of the most successfully introduced of the proprietary clam extracts is made by the following process:

The uncooked clams are placed in a retort or receptacle, which is preferably air and steam tight, and live steam is admitted into said retort for 20 minutes, or more or less, as may be desired. The steam causes the shell or clam to open, thus liberating the liquid or juice from the solid meat of the clams, and said liquid drops into suitable pans placed for the purpose under the clams, the latter being supported by suitable open racks or gratings. The juice or liquid extract thus obtained is next passed through a suitable filter, and is then boiled to evaporate a part of the water and concentrate the extract, thus making a given quantity of it richer than it would otherwise be. The boiling also cooks the nutritive elements in the liquid sufficiently to prevent ready decomposition when exposed to the air. The liquid is finally put, while hot or cold, into cans or jars and hermetically sealed, the time of processing or cooking the jars or cans, so as to exclude the air and have it keep in any climate, varying as to whether the concentrated juice or extract is filled into the cans or jars hot or cold. (Letters Patent No. 395199, dated December 25, 1888.)

Large quantities of extract are made from soft clams at several points on the Maine and Massachusetts coast after the last-described process, the product being placed on the market in pint, quart, and gallon tin cans and selling at about $2.50 per dozen pint cans, and at proportionate prices for cans of other sizes. The surplus liquor from clams used in the canning factories forms the crude material and this is evaporated and prepared in the manner described above. In discussing the introduction and use of this extract the inventor states:

It has been adopted in very many hospitals, hotels, and large public institutions; it is being prescribed as a valuable stomachic by thousands of physicians, and is already being sold by very many of the leading grocers throughout the United States and foreign countries to families who use it as food in its various forms upon their tables. Another use to which it is getting to be largely put is in making instantaneous hot clam broth or bouillon by dispensers of temperance drinks, being in this way used in conjunction with water or milk, making, with the addition of pepper or salt, a very nutritious and palatable drink. Although this "extract of clams" is of recent introduction, yet the sales have already reached several thousands of cases per year, and the demand is steadily increasing as the people find out the merits of the article. The prices of this new food are reasonable, so that those who are in moderate circumstances can afford to purchase it, the retail price for pint tins not exceeding 30 cents per tin and for the gallon tins not exceeding $1.50 per tin in the United States and the principal European centers of trade.

There are several brands of clam extract or bouillon on the market, made from hard clams or quahogs. These are prepared in various ways, and usually, as in case of extract of soft clams, as a by-product in the canning of the quahogs. At one establishment in New York State the hard clams are steamed for the purpose of opening them, the escaping liquid being saved and placed in tin cans, processed heavily, and sealed, the meats being similarly treated and canned separately. It is claimed by some that this process is objectionable, especially in the manner of opening the clams by steaming. The hot steam coming in contact with the cold shells condenses somewhat and adds to the bulk of the liquor, thereby weakening it; also, when the shells are heated they impart a peculiar flavor to the liquor. As this preparation is not evaporated, diluting it with the condensed steam is especially undesirable. It sells for about $1.75 per dozen 1-pound cans.

At another factory in New York State for preparing clam juice the clams were formerly opened with a knife, all the free liquor being saved and the meats chopped and compressed to obtain additional liquor. This was compressed and the liquid condensed, leaving the clear juice somewhat concentrated. It was soon found more profitable to use the meats in preparing clam chowder, and at present that is one of the principal products of the establishment. The raw clams are opened with a knife, all the liquor being saved. The meats, with sufficient liquor, are then mixed with disks of white potatoes, onions, and other vegetables to suit the taste, just as in preparing chowders at home, placed in tin cans, processed, vented, and hermetically sealed. The surplus liquor is condensed by evaporation and placed in glass jars, which are then sealed. A large spoonful of this juice is sufficient for a cup of bouillon after mixing with water.

Some clam juice is prepared on the North Carolina coast, and occasionally in the Chesapeake region a few cases are prepared experimentally and an attempt is made to market them. This usually results in a loss because of the article being unknown, considerable work being necessary to build up a market for a new brand of clam juice.

In 1897 there was introduced in Scotland a method of preparing an extract of clams or other shellfish mixed with a sufficient quantity of seaweed, such as Irish moss or carrageen, to convert it into a jelly,* for use as a "stock" in making soups, sauces, and the like.

The process of preparation is as follows:

Boil a quantity of clams or other shellfish in a close-covered vessel, using the smallest quantity of water necessary for the purpose. After the mollusks are sufficiently cooked, remove the shells, bruise or reduce the flesh to a pulp, and strain off all the extracted liquor from it. To this liquid extract add the water used in cooking and the liquid resulting from opening the mollusks. Then boil this liquid with a quantity of Irish moss or carrageen, or any seaweed having similar properties, which has been well bleached to remove color, apportioning the quantity of Irish moss and timing the boiling operation to obtain a jelly of the desired consistence. Before boiling the moss and liquid, or during that operation, add salt, pepper, and other flavoring condiments desired. Strain the product while hot and store it in stoneware jars or other receptacles, which may be sealed up.

* Letters Patent No. 585395, dated June 29, 1897.

MISCELLANEOUS ANTISEPTICS AND ANTISEPTIC PROCESSES.

There are a number of antiseptics which have been brought to the attention of fish-curers for use in preserving their products, in addition to those already noted. The most desirable are those that do not change the texture of the fish, as common salt does, among these being boracic acid, salicylic acid, citric acid, tartaric acid, etc. The first is considered a valuable preservative, as it keeps fish and other food stuffs fresh for a week or more without great injury either to the appearance or quality of the articles preserved, and it is used more extensively than all others, but usually only as an aid to other methods of preservation.

BORACIC ACID.

For many years the value of boracic acid as a preservative agent has been recognized. Its extensive use with articles of food appears to have originated in Norway about 1870. Among the articles preserved by its agency were herring, and the success with them was such that the trade gradually extended beyond the boundaries of the country and in 1885 they were shipped to England in large quantities, successfully competing with fresh herring from Yarmouth and other points of Great Britain.

The general method of application is as follows: The round herring are arranged in layers in a barrel and each tier covered with a thin layer of a mixture made of 5 pounds of boracic acid and 10 pounds of fine salt. When full the barrel is tightened down in the usual way and the contents pickled with a weak solution of boracic acid and fresh water. The fish should then be kept in a cool place at an even temperature. In treating a barrel of herring in this way, 2½ pounds of boracic acid and 5 pounds of salt are required for spreading on the fish during packing, and about 10 ounces of acid for dissolving in the water used for pickling. The cost is about 8 or 10 cents per pound, wholesale.

Some objection has been raised to the use of boracic acid as a preservative because of its alleged injury to health. In opposition to this it is stated that it has been used for years, especially to preserve milk in hot weather, and no evidence has appeared to indicate injurious effects upon the health. The Norwegian herring preserved with boracic acid are said to be of good quality and to be in fair condition when placed on the markets, even after being two weeks out of the water.

In discussing the curing of fish with boracic acid, the British Medical Journal states:

Large quantities of herring preserved with salt and boracic acid being at present imported from Norway and sold in the London and Newcastle markets, attempts have been made to prevent their sale. The National Sea Fisheries Protection Association discussed the question at a recent conference at Fishmongers' Hall, but no decision as to such fish was arrived at. It may, therefore, be worth while to point out that boracic acid being the essential ingredient of our many food preservatives, be it in the form of the acid, of boroglyceride, or of borax, has been used for years, especially to preserve milk in hot weather, and no evidence has ever been brought forward even to suggest injurious

effects upon the health; it may, therefore, be taken to be perfectly harmless. The Norwegian herrings preserved with salt and boracic acid are of exceptionally fine quality, are perfectly fresh when brought into the market, and are, of course, subject to the usual process of inspection by the market inspectors, whose power of rejection is almost absolute. If, nevertheless, an outcry is heard against their sale, it is difficult to resist the belief that it is dictated by the jealousy which is notoriously rife in Billingsgate circles. The introduction of cheap food from new sources, welcomed as it always is by the public, is invariably opposed by the trade, who, after all, reap the chief advantage in the long run. One has but to recall the sneers of the meat venders at American and Australian meat to value the agitation against Norway herrings at its proper worth. Hitherto, happily, we have been spared the bitter discussions which have on the Continent led to legislation against certain food preservatives, such as salicylic acid, which we in England admit without hesitation. The question is mainly one of public economy. Shall good food be wasted for want of a preservative, even if certain objections may be urged against their use, or shall we put up with these objections and aim at cheapening food for the masses, provided, always, that nothing which could injuriously affect their health is allowed to be present? A sufficient guaranty is afforded by the vigilance of medical officers, public analysts, and market inspectors against the abuse of antiseptics and food preservatives.

On the other hand, a fish-dealer writes to the *Fish Trades Gazette:*

Hundreds of barrels of herring from Norway out of one cargo were condemned, and there were about 1,500 barrels unsold lying in London at that time. France will not admit Swedish and Norwegian herring, nor any other fish cured by the process named. Many shopkeepers soon find out to their cost that once their customers have tasted herring cured with acid they don't ask for them a second time.

A combination of boracic and acetic acids for preserving food products was introduced in the United States in 1877 by C. G. Am Ende, who thus describes his invention:

The invention consists in compounding boracic acid, either in a liquid or pulverous state, with acetic acid, in the proportion of about one drop of acetic acid to every ounce of boracic acid; but the proportion may be varied, according to the nature of the substance to be preserved, and of the atmosphere to which the same is to be exposed. The acetic acid may be used more or less diluted. Other salts may be added to the mixture if desired. The composition is applied to the substances to be preserved in substantially the manner in which preservatives are usually applied. The acetic acid in the composition prevents the formation of fungi, while the boracic acid prevents putrefaction chiefly by hindering the formation of bacteria. (See Letters Patent No. 187079, dated February 6, 1877.)

ROOSEN PROCESS.

This process, invented by August Roosen, of Hamburg, consists in placing the freshly caught fish in an air-tight barrel, and then forcing the preservative solution into the tissues of the fish by using a pressure of several atmospheres. The details of the process are as follows:

A strong cask of galvanized iron with an adjustable lid is provided. This resembles somewhat the well-known cans used for conveying milk, but is much larger. As many fresh fish as the cask will conveniently hold are placed therein, and the cask is filled with water and certain proportions of boracic acid and tartaric acid. The purpose of the tartaric acid is to neutralize the taste of the boracic acid, which, however, is quite harmless. The lid, fitted so as to be air-tight, is next adjusted and secured to the cask. A small force pump is connected with a hole in the lid, and additional quantities of a solution of the antiseptic in water are pumped into the cask, expelling all air, which escapes at a second hole in the lid. As soon as the cask is completely full and the air expelled, the liquid begins to flow through the second aperture. An air-tight cap is then screwed tightly over this hole to prevent further escape of the liquid. The pump is again set to work forcing in the mixture until a gauge fixed to the pump indicates a pressure of 90 pounds to the square inch. By means of a stopcock the opening is then closed and the air pump removed. The effect of the high pressure is to force the mixture into the veins and tissues of the fish and thus prevent organic change in any part. The fish are shipped in the cask, and it is stated that they will keep for any reasonable length of time in any climate.

It is claimed that the cost of utensils required for the preservation of fish according to the above process amounts in this country to about $30, the cost of a cask being $20 and of a pump $10. The cask should be made of stout steel, and capable of containing 200 or 300 pounds of fish. The utensils should last five years, and one pump is sufficient for a large number of casks. If the cost of materials be distributed over five years, the average cost will be $6 per year, so that in case the cask is filled only once a year the cost of utensils and materials is a trifle over 2 cents per pound of fish. But as each cask may be filled twenty times a year, and one pump will suffice for a large number of casks, the cost is reduced to one-tenth of 1 cent per pound.

The following extract is from an article in the *Fish Trades Gazette*, of London, July 31, 1886:

The Roosen process is now pretty well known in England, and it is generally accepted as being far the most successful attempt to keep fish not only fresh, but also sweet, wholesome, and attractive for long periods. The process, it may be added, is not confined to fish, but has been applied with equal success to meat, game, fruit, etc. Experiments have been carried out in Scotland, and public demonstrations of the value of the process made in Edinburgh and Glasgow, where its merits have been recognized by the very highest authorities on the subjects of fishing and the fish trade. Messrs. Dufresne & Luders, the agents of Mr. August R. Roosen, of Hamburg, the inventor of the process, lately decided that it would be well to make the process better known in London, and accordingly invited a number of representative guests to witness the opening of several casks of fish preserved by the Roosen process and to taste the same when cooked. There was an excellent response to the invitation, the guests including many famous authorities in science and in medicine, as well as others holding important governmental positions or being connected with commerce, not only in England, but also in the colonies and Indian Empire. Two casks, which had been closed for seventeen days, were opened before the company, and the fish when taken out were found to be perfectly sweet and fresh, bright-looking, and as attractive as the day they were caught. On being eaten they were pronounced excellent, and the advantages of the process were highly commended.

A process somewhat similar to that introduced by Roosen was devised* by Magnus Gross, of Washington, D. C., in 1859. Gross's method differed from Roosen's in employing hydrostatic pressure instead of a force pump and in using a strong solution of common salt (100 pounds) mixed with carbonate of soda (4 pounds) and carbonate of potash (2 pounds). This method was intended for the preparation of salted fish, the product being packed in dry salt after the curing process, and it was never used to any commercial extent.

ECKHART PROCESS.

In 1877 John Eckhart, of Munich, Germany, patented† a process of preserving fish and meats by introducing a solution of salicylic acid with an apparatus similar to that used in the Roosen process for preserving fresh fish. The solution was made by dissolving half a pound of salicylic acid in 100 pounds of water. A hydraulic pressure of 12 atmospheres was applied for from one to two hours. In 1882 Eckhart introduced another antiseptic compound‡ for fish, salt, boracic acid, tartaric acid, and salicylic acid being used instead of boracic acid alone. The mixture was composed of 50 per cent salt, 47½ per cent boracic acid, 2 per cent tartaric acid, and ½ per cent salicylic acid. In its application the fish are stripped of skin and bones and mixed with the compound in the proportion of 2 pounds antiseptic to 100 pounds of fish. They are next packed in cases of animal tissue or parchment and put into casks filled with a gelatin solution made in the proportion of 10 pounds of gelatin, 4 pounds of the anti-

* Letters Patent No. 26427, December 13, 1859.
† Letters Patent No. 194550, August 28, 1877.
‡ Letters Patent No. 251772, January 3, 1882.

septic, and 25 gallons of water. The casks are then headed and connected with a force pump and more of the solution is forced in until the contents are well saturated. The fish may then be shipped in the casks or they may be removed from the cases, sprinkled with dry salt, and marketed dry.

JANNASCH PRESERVATIVE.

A compound patented by Hugo Jannasch, of Germany, and in use at Gloucester and some other ports, is said to be prepared in the following manner:

Equal parts of chloride of potassium, nitrate of soda, and chemically pure boracic acid are dissolved in the proper quantities of water. A solution of chloride of potassium is then heated in a kettle up to the boiling point, and a solution of nitrate of soda added thereto. This solution is kept on a brisk fire until the lye has become perfectly clear. The solution of boracic acid is then added under continual stirring. By the influence of the boracic acid, at a temperature of 212° F., a reaction takes place, which is indicated by the mass assuming a yellowish color, and by the escape of chlorine gas. After the reaction has taken place the solution is slowly evaporated at a low temperature, until a dry salt is obtained, which is composed of a combination of hyponitrate of potash, hypochlorate of soda, borate of soda, borate of potash, and free boracic acid.

In the application of this compound to the preservation of fresh, pickled, smoked, or dry-salted fish the following directions are given:

In preserving fresh fish which are to be shipped or kept on the stand for sale, remove the entrails, sprinkle some of the preservative inside the fish, also in the bottom of the box or barrel in which the fish are to be packed; then place the fish in the box and sprinkle the preservative over each layer. If the entrails and gills are not taken out, insert, according to the size of the fish and the season of the year, more or less of the compound in the mouth of the fish, pushing it down as far as posssible; then sprinkle some on the gills, after which treat the fish as above when packed in box or barrel. Use 1 pound of preservative to 100 pounds of fresh fish. Pickled fish, if packed in kegs or barrels, are treated first in the way directed above. The barrels are then headed up and allowed to stand from 4 to 6 hours; then the pickle, which can be made much milder than the present pickle for fish, is added, and the barrels are rolled to facilitate and quicken the dissolving of the preservative. The pickle should be admitted through the bunghole only, to prevent the preservative from being washed off. To prevent the brine from souring and to enable its being used several times over again, it is recommended that to every 6 gallons of brine 1 pound of preservative be added, first dissolving the compound in a gallon of hot water, and after it has cooled off pouring it into the brine. Every time the pickle is used over again add sufficient salt to bring it back to the requisite strength; then use only half the quantity of preservative taken the first time, which would be ½ pound of preservative for every 6 gallons of pickle. By this treatment the pickle will remain sweet and free from slime for a long time, and thus save the labor and expense of making new brine.

MISCELLANEOUS ANTISEPTIC COMPOUNDS.

While boracic acid and other chemicals have not been extensively used in the United States for preserving fresh fish, they have been employed to a considerable extent since 1881 in connection with other processes of preservation. Boracic acid has long been used in a powdered form on dry-salted cod, especially those put up as boneless fish. Its popularity has increased under various names, and it is now employed at several boneless-cod, oyster-shucking, and other establishments. It has been used to some extent in the preservation of caviar, but salicylic acid seems better adapted for this purpose. Most of the preservative antiseptics used are proprietary compounds sold under various trade names, such as "Preservaline," "Rex Magnus," etc. The following antiseptic compounds have been introduced. This summary has no pretensions to completeness, there being scarcely any limit to the number of compounds brought to the attention of fish-curers.

Hydrocarbon gas.—This is substituted for the air which occupies the space in and around the substance to be preserved, subjecting the same to a temperature of about 30° F. The gas is let into the package through a hole in the top and the air escapes through a hole in the bottom, and both holes are then closed. (Letters Patent No. 45765, dated January 3, 1865.)

Sulphides of carbon.—Fish are placed in a receiver and the air exhausted. Gaseous bisulphide, protosulphide, or other sulphide of carbon is then let into the receiver under pressure and permeates the flesh. In combination with the sulphide is used phenic acid, methyl or other product of the destructive distillation of wood. (Letters Patent No. 85184, dated December 22, 1868.)

Gelatin, lime, glycerin, etc.—Put the fish in an air-tight compartment and exhaust the air with a vacuum pump, then by means of a force pump introduce a solution of gelatin and bisulphite of lime. When completely saturated remove the fish and dip them in a concentrated solution of gelatin containing bisulphite of lime, glycerin, sugar, and gum. (Letters Patent No. 90944, dated June 8, 1869.)

Glycerin.—Remove from the fish all the refuse matter, such as skin, bones, etc., and then grind the residue and compress from it the watery portions, blood, and oily matter to whatever extent may be desirable, and then treat it with glycerin, regrinding the material during this process. The fish is then pressed into a compact mass and placed in any suitable wrapper of tin foil or other material, or boxed. (Letters Patent No. 87986, March 16, 1869.)

Glycerin and antiseptic salts.—Oysters, fish, and meats may be preserved by use of a mixture of glycerin with phosphate of soda, or other antiseptic salt in connection with aldehyde, formic ether, or acid in a solution of carbonic acid, water, glycerin, etc., and the preserved substance is then covered with parafin or stearin. (Letters Patent No. 93183, dated August 3, 1869.)

Saltpeter and alum.—The fish, either after or before they have been salted, are placed for 4 hours in a solution of saltpeter and alum, made in proportion of 5 pounds of saltpeter and 4 ounces of alum to 60 gallons of sea water. They are then dried either in the sun or by artificial means. If they are to be smoked, 2 hours in the solution is said to be sufficient. It is claimed that this process removes all tendency to sweat or decay. (Letters Patent No. 95179, dated September 28, 1869.)

Soda and carbolic acid.—After being cleaned the fish are dipped in a solution in proportion of 5 gallons of water, 2 pounds of sulphite or bisulphite of soda, and 2 ounces of carbolic acid in crystals. Oysters, clams, etc., may be dipped in a solution of their own liquor and the chemicals. (Letters Patent No. 86040, January 19, 1869.)

Thymol or thymate salts.—Place the fish, oysters, meats, or other animal substances to be preserved in solutions of thymol, thymic acid, or any of the thymate salts and water, alcohol, or glycerin, etc. (Letters Patent No. 108983, dated November 8, 1870.)

Chloroform and ether, etc.—The meat or fish is placed in air-tight packages, into which is poured a small quantity of chloroform, which becomes vaporized and surrounds the substance with an atmosphere of vapor which acts as a preservative. The cans are then sealed and are ready for shipment. When needed for use the chloroform is removed by means of an air-pump. (Letters Patent No. 128371, dated June 25, 1872.)

Borax, saltpeter, etc.—By the Herzen preserving process, meat is soaked from 24 to 36 hours in a solution of 3 parts borax, 2 boracic acid, 3 saltpeter, and 1 salt, in 100 parts water, then packed in some of the solution. Before use the meat must be soaked 24 hours in fresh water.

Bisulphite of lime.—The Medloch & Bailey method of preserving is said to be one of the most successful of antiseptic processes. The solution used is made of equal parts of water and bisulphite of lime of 105 sp. gr. Fish cured in this solution are claimed not to have an unpleasant flavor.

Acetate of alumina.—Meat and fish are covered with a coating of gum, then immersed in acetate of alumina, then a solution of gelatin, allowing the whole to dry on the surface. The antiseptic acetate of alumina forms an insoluble compound with the gelatin and prevents decomposition by excluding air from the substance.

Benzoin and alum.—In the preservation of meat and fish by the Pagliare process they are immersed in a compound of gum benzoin boiled in a solution of alum, and excess of moisture is driven off by a current of hot air, leaving the antiseptic on the surface of the fish or meat.

Salicylic acid and alcohol.—To 50 grams of salicylic acid is added 300 grams of rectified alcohol. White blotting paper is well saturated in this mixture and left to dry. By this mixture the paper becomes full of little red pricks and has a sweetish taste. The fish are wrapped in this paper and packed rather loosely in dry hay. By this method it is claimed that fish or game can be transported at any time during the summer without danger of spoiling.

Bicarbonate of soda and saccharine matter.—Take 40 parts of bicarbonate of soda and 60 parts of saccharine matter, such as sugar, and mix them in enough water to form a thick paste or sirup, which is applied with a brush to the surface of the fish to be preserved. The fish so coated are suspended in a shady place for an hour or so and then exposed to an air current until the surface is thoroughly dried. By soaking the fish in water for 3 hours or more the coating is dissolved, when the fish may be prepared for the table. (Letters Patent No. 474581, dated 1892.)

Fluoride of sodium and chloride of sodium.—A mixture made of 80 parts fluoride of sodium with 20 parts of common salt gives the best results, but the proportions may be varied according to conditions. This may be used either in the form of a powder or dissolved in water. When the fish are to be preserved a considerable length of time they should be soaked in the antiseptic solution; but when they are to be preserved for a short time only they may be sprinkled with the powder. It is claimed that this antiseptic does not exert an injurious influence on the digestive fluids, but on the contrary is rather beneficial.

Miscellaneous.—The following is said to be the composition of a number of proprietary antiseptics used in Europe and to some extent in this country:

Composition.	Per cent.	Composition.	Per cent.
Sozolithe:		The "Minerva" Chinese preservative:	
Sulphite of ammonia	37.3	Chloride of sodium	25
Sulphurous acid	39.7	Boric acid	17.7
Soda	21	Sulphate of soda	38.8
Water	2	Sulphite	9.2
Concentrated berlinite:		Water	9.3
Crystallized borax	82.7	Australian salt:	
Boracic acid	9.8	Crystallized borax	94
Chloride of sodium	7.5	Chloride of sodium	5.5
Paechel berlinite:		Some hydrocarburet	.5
Chloride of sodium	45.9	Rugers barmenide:	
Nitrate of potash	32.3	Boric acid	50
Boric acid	19.3	Chloride of sodium	50
Water	2.5		

MOSS WATER.

Among the "Papers in Colonies and Trade" for 1820 a somewhat novel method of preserving herring by means of moss water was described by J. Fred. Denovan, one of the pioneers in developing the pickled-herring trade of Scotland. His description is as follows:

Having often observed the strong antiseptic powers of moss water on vegetable and animal substances, I conceived that it might be used with effect in the cure of herrings, particularly of those intended for a warmer climate, and I resolved to try the experiment on a small scale: I first cured a few kegs of the later herrings (in October, 1818) in the usual way; but instead of throwing away the gut, gills, and bloody part, as is customary, I put them into a small cask with a proportionate quantity of Lisbon salt, and pressing down the whole by means of an iron plate a dissolution of the salt took place in a few hours, and a strong red pickle was produced, on the top of which the fixed oil was floating. After carefully skimming off the oil, I added one-third of strong brown moss water taken from a natural pond formed in the moor near Eyemouth; and having taken the herrings out of the original pickle, I packed them anew and filled up the kegs with this pickle. On opening them some months afterwards I not only found they were in excellent preservation, but that the scales (which always proves the quality of the pickle) were as bright as when the fish were taken out of the water.—("Papers in Colonies and Trade" for 1820, p. 195.)

PRESERVATION BY COMPRESSED AIR.

Various experiments have been made in preserving meat and fish by compressed air. One of the most important processes is that known as Brandt's method, devised by Martin Brandt, of Denmark. A brief review of this process and its importance to the fish trade appears in the *Deutsche Fischerei-Zeitung* July 8, 1884, from which we quote the following:

Martin Brandt's new method is said to have this advantage, that it does not change the shape, looks, and flavor of the fish, and prevents the development of fungus. It is done by compressed air. It may be continued for an unlimited period and be employed in the holds of vessels, railroad cars, warehouses, etc. For lining the rooms where the fish are kept metal or cement is used. The preserving medium weighs very little, as 1,000 cubic feet of compressed air weigh but 10 pounds. In Mr. Brandt's warehouse a pipe runs along the wall from the floor to the ceiling, and back again, twisting several times, and finally ending on the floor. The machine or development apparatus consists of an iron cylinder connected with a so-called vacuum air filter. The cylinder is filled with air compressed by about 200 atmospheric pressure. By means of the vacuum apparatus the machine is connected with the pipe in the warehouse, and the compressed air flows, after a valve has been opened, with great velocity through the filter and the pipes. New air is also introduced in the vacuum apparatus through cotton filters, thus purifying it of all matter apt to decay, and, united with the stream of compressed air, it continues to pass through the pipes. As the air expands it loses some of its warmth and is gradually cooling off. When let out of tho pipes the air, which has now become quite cool, rises evenly throughout the room and drives the warm air, filled with germs or fungi, through an opening in the ceiling. As the inventor claims, fish and meat can be kept fresh for an unlimited period in rooms whose air has been purified in the manner described above. (Translated in U. S. Fish Commission Bulletin, 1884.)

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